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Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Ink Formulating Point Source Category

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This document presents the findings of an study of the Ink Manufacturing Industry for the purpose of developing effluent limitations and standards, and pretreatment standards for existing and new sources to implement Sections 301, 304, 306, 307 and 501 of the Clean Water Act. The study covers approximately 460 ink manufacturing facilities in SIC Group. 2893.

Effluent limitations guidelines are set forth for the degree of effluent pollutant reduction attainable through application of best available technology economically achievable which must be attained. The standards of performance for new sources (NSPS) set forth the degree of effluent pollutant reduction that is achievable through the application of the best available demonstrated control technology. Pretretament standards for exisiting and new sources (PSES and PSNS) set forth the degree of effluent pollutant reduction that must be achieved in order to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation POTW.

The proposed regulations for BAT, NSPS, PSES and PSNS are based on application of contract hauling to completly eliminate the discharge of pollutants from ink plants.

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DEVELOPMENT DOCUMENT

for

PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS

for the

INK FORMULATING POINT SOURCE CATEGORY

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ABSTRACT

This document presents the findings of an extensive study of the ink manufacturing industry for the purpose of developing effluent limitations for existing point sources and standards of performance for new sources and pretreatment standards for existing and new sources to implement Sections 301, 304, 306 and 307 of the Clean Water Act. The study covers approximately 460 ink manufacturing facilities in SIC Group 2893.

Effluent limitation guidelines are set forth for the degree of effluent pollutant reduction attainable through application of best available technology economically achievable which must be attained by existing point sources by July 1, 1984. The standards of performance for new sources (NSPS) set forth the degree of effluent pollutant reduction that is achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives. Pretreatment standards for existing and new sources (PSES and PSNS) set forth the degree of effluent pollutant reduction that must be achieved in order to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTW.

The proposed regulations for BAT, NSPS, PSES and PSNS are based on application of contract hauling to completely eliminate the discharge of pollutants from ink plants.

Supportive data, rationale, and methods of the proposed effluent limitation guidelines and standards of performance are contained in this document.

TABLE OF CONTENTS

Section | | Page
I CONCULSIONS 1

II RECOMMENDATIONS 3

III INTRODUCTION 5
- Purpose and Authority 5
- Summary of Methodology 7
- Data and Information Gathering Program 8
- General Description of the Industry 10
  - Number of Manufacturing Sites and Employment 11
  - Ink Industry Sales 14
  - Geographic Distribution of Ink Plants 14
  - Organization of Ink Plants 18
  - Age Distribution of Ink Plants 18
  - Batch Sizes and Available Tankage 18
  - Periods of Operation 22
  - Production Characteristics 22
  - Raw Materials 23

IV INDUSTRIAL SUBCATEGORIZATION 31
- Introduction 31
- Rationale for Subcategorization 31
- Raw Materials and Products 31
- Production Methods 31
- Size and Age of Production Facilities 32
- Wastewater Constituents 32
- Tub Cleaning Techniques 32

V WATER USES AND WASTEWATER CHARACTERIZATIONS 35
- Water Use 35
- Wastewater Sources 35
  - Tub and Equipment Cleaning 35
  - Other Pollutant Sources 41
- Wastewater Volume 43
- Wastewater Characterization 46
- Sampling Data 50
  - Mass Loadings 63
  - Resampling 66

VI SELECTION OF POLLUTANT PARAMETERS 69
- Introduction 69
- Methodology 69
  - Raw Materials Evaluation 70
  - Raw Materials Survey 70

Sampling Program 73
Plant Location 73
Plant Size 73
Wastewater Treatment 76
Toxic Pollutants 76
Direct Dischargers 76
Selection of Sampling Sites 76
Toxic Pollutants 77
Pesticides and Metabolites 77
PCB's 78
Phenolic Compounds 79
Volatile Organic Toxic Pollutants 79
Halomethanes 79
Chlorinated Ethanes 80
Aromatic Solvents 81
Chloroaklyl Ethers 82
Dichloropropane and Dichloropropene 82
Chlorinated Ethylenes 82
Miscellaneous Volatile Organics 83
Semi-Volatile Organic Priority Pollutants 83
Polynuclear Aromatics (PNA's) 83
Chlorobenzenes 84
Phthalate Esters 84
Haloethers 85
Nitrosamines 86
Nitro-Substituted Aromatics Other than Phenols 86
Benzidine Compounds 86
Miscellaneous Semi-Volatile Organic Toxic Pollutants 86
Inorganic Toxic Pollutants 87
Conventional Pollutant Parameters 87
Nonconventional Pollutant Parameters 88

VII CONTROL AND TREATMENT TECHNOLOGY 89
In-Plant Wastewater Control Strategies 89
Wastewater Reduction 89
Wastewater Recycle 90
Wastewater Disposal 92
Wastewater Treatment 92
Preliminary Treatment Systems 94
Physical-Chemical Treatment 94
Other Wastewater Treatment Systems 97

VIII COST, ENERGY, AND OTHER NONWATER QUALITY ASPECTS 99
Costs 99
Historical Cost Information 99
Cost Development 99

Physical-Chemcial Precipitation 102
Manual Physical-Chemical Treatment System 105
Wastewater Disposal by Contract Hauling 105
Wastewater Reduction System 105
Nonwater Quality Aspects 112
Energy 112
Sludge Quantity and Characteristics 112
Solvent-Wash Subcategory 112

IX EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE EFFLUENT LIMITATIONS GUIDELINES 115
Introduction 115
Identification of BAT Technology 116
Technology Options Available 116
Rationale Used to Develop BAT Effluent Guidelines 117
Size, Age, Production Methods, Raw Materials and Products, Tub Cleaning Techniques 117
Engineering Aspects of Best Available Technology Economically Achievable 118
Nonwater Quality Environmental Impact 118
Total Cost of Application in Relation to Effluent Reduction Benefits 118
BAT Effluent Guidelines 119
Regulated Pollutants 119

X NEW SOURCE PERFORMANCE STANDARDS 121
Introduction 121
Identification of New Source Performance Standards 121
Rationale Used to Develop NSPS Effluent Limitations 121
Size, Production Methods, Raw Materials and Products, Tub Cleaning Technqiues 121
Engineering Aspects of New Source Performance Standards 121
Nonwater Quality Environmental Impacts 122
Total Cost of Application in Relation to Effluent Reduction Benefits 122
NSPS Effluent Limitations 122
Regulated Pollutants 122

XI PRETREATMENT STANDARDS FOR EXISTING SOURCES 123
Introduction 123

Identification of Pretreatment Standards 124
Rationale Used to Develop Pretreatment Standards for Existing Sources 124
Size, Age, Production Methods, Raw Materials, and Products, Tub Cleaning Techniques 125
Engineering Aspects of Pretreatment for Existing Sources 125
Nonwater Quality Environmental Impacts 125
Total Cost of Application in Relation to Effluent Reduction Benefits 126
Pretreatment Standards For Existing Sources 126
Regulated Pollutants 126

XII PRETREATMENT STANDARDS FOR NEW SOURCES 129
Introduction 129
Identification of New Source Pretreatment Standards 129
Rationale Used to Develop PSNS Effluent Limitations 129
Size, Production Methods, Raw Materials and Products, Tub Cleaning Techniques 129
Engineering Aspects of New Source Performance Standards 129
Nonwater Quality Environmental Impacts 130
Total Cost of Application in Relation to Effluent Reduction Benefits 130
Pretreatment Standards For New Sources 130
Regulated Pollutants 130

XIII ACKNOWLEDGMENTS 131

XIV REFERENCES 133

XV GLOSSARY 137

APPENDIX A 149
APPENDIX B 165
APPENDIX C 171
APPENDIX D 175
APPENDIX E 185
APPENDIX F 195
APPENDIX G 199
APPENDIX H 207
APPENDIX I 221

LIST OF TABLES

Table No.	Title	Page
III-1	Number of Production Employees in Ink Plants (1976)	12
III-2	Ink Industry Profile - 1972 Census of Manufacturers	13
III-3	Geographical Distribution of Ink Plants	16
III-4	Distribution of Ink Manufacturing Plants by State	17
III-5	Ink Industry Breakdown by Age	19
III-6	Number of Ink Plants with Tubs of Various Sizes	20
III-7	Total Ink Industry Tankage	21
III-8	Production Breakdown of Ink Plants	24
III-9	Production Breakdown of Ink Plants by Vehicle	25
III-10	Comparison of Plants Specializing in Water-Base and Solvent/Oil-Base Ink	26
III-11	Comparison of Organic and Inorganic Pigments Used in Ink Plants	27
III-12	Slopes and Correlation Coefficients for Plots of Percent Toxic Pollutants Usage Versus Percent Solvent-Base Ink Production	29
V-1	Total Water Usage by the Ink Industry	36
V-2	Percent Water Usage in Ink Plants	37
V-3	Methods of Tub Cleaning Used by Ink Plants	38
V-4	Amount of Water Used to Clean an Ink Tub	42
V-5	Other Pollution Sources	44

V-6	Wastewater Generation by the Ink Industry	45
V-7	Volume of Wastewater Generated by Ink Plants Producing Only Water-Base, Oil-Base or Solvent-Base Ink	47
V-8	Wastewater Discharge by the Ink Industry	48
V-9	Volume of Wastewater Discharged by Ink Plants Producing Only Water-Base, Oil-Base, or Solvent-Base Inks	49
V-10	Constitutuents of Ink Manufacturing Plant (SIC 2893) Wastes in East Bay Municipal Utilities District	51
V-11	Waste Characterization from an Ink Tub Washer that Recycles the Wash Water (10/15-18/1973)	52
V-12	Characterization of Ink Plants Participating in the 1977 Sampling Program	53
V-13	Characteristics of Ink Sampling Plants	54
V-14	Toxic Pollutants Found in Sampling Plant Raw Materials	55
V-15	Untreated Wastewater Data Summary (1977/78 Sampling Program)	56
V-16	Treated Wastewater Data Summary (1977/78 Sampling Program)	58
V-17	Intake (Tap) Water Data Summary (1977/78 Sampling Program)	60
V-18	Untreated Wastewater Mass Loading	64
V-19	Results of Resampling at Two Ink Plants (One Year Interval)	67
VI-1	Occurrance of Toxic Pollutants in Ink Raw Materials	71
VI-2	Toxic Pollutants Found in Raw Materials Used by the Ink Industry	74

VI-3 Distribution of Ink Plants in Major Metropolitan Areas 75

VII-1 Frequency of Tank Cleaning and Reuse of Ink Wastewater 91

VII-2 Wastewater Disposal Methods 93

VII-3 Untreated and Treated Wastewater Concentrations and Percent Removals from Ink Plant 22 95

VIII-1 Cost of Sludge or Wastewater Removal by Contract Hauler 100

VIII-2 Physical-Chemical Treatment System Design Data 103

VIII-3 Physical-Chemical Pretreatment Systems Capital Costs 104

VIII-4 Physical-Chemical Pretreatment Systems Operating Costs 106

VIII-5 Manually Operated Physical-Chemical Pretreatment Systems Capital Costs 107

VIII-6 Manually Operated Physical-Chemical Pretreatment Systems Operating Costs 108

VIII-7 Wastewater Disposal by Contract Hauling Capital Costs 109

VIII-8 Wastewater Disposal by Contract Hauling Operating Costs 110

VIII-9 Wastewater Reduction Through High Pressure Tank Rinsing Capital Costs 111

LIST OF FIGURES

Figure No.	Title	Page
III-1	Geographical Distribution of Ink Manufacturing Sites	15
VII-1	Flow Diagram for a Batch Physical-Chemical Treatment System	96

SECTION I

CONCLUSIONS

For the purpose of establishing wastewater effluent limitation guidelines for existing sources and standards of performance for new sources the ink manufacturing point source category has been subcategorized as follows:

1. Solvent-wash
2. Caustic and/or water-wash

Tub cleaning techniques constitute the only valid technical basis for subcategorization; raw materials and production methods are not valid bases for subcategorization except as they influence tub cleaning techniques. Production methods, size, age, and wastewater constitutents of ink manufacturing facilities were not found to be a basis for subcategorization.

The most significant pollutants and pollutant parameters appearing in the industry wastewater in terms of occurence and concentration include: the nonconventional and conventional pollutants BOD_5, TSS, pH, COD, and oil and grease; and the following toxic pollutants:

Chromium(Total)
Copper (Total)
Lead (Total)
Zinc (Total)
Isophorone
Di-n-octyl Phthalate
Trichloroethylene
Ethylbenzene
Methylene Chloride
1,2-Diphenylhydrazine
1,1,1-Trichloroethane
Pentachlorophenol
Di(2-ethylhexyl) Phthalate
Tetrachloroethylene
Toluene

All discharges of these pollutants will cease under proposed best available treatment economically achievable (BAT), new source performance standards (NSPS), and pretreatment standards for new and existing sources (PSNS and PSES).

The Agency estimates total investment costs for the proposed regulations (BAT, NSPS, PSNS, PSES) to be 1.5 million dollars. Associated annualized costs (including interest, depreciation, operation, and maintenance) are estimated to be 3.0 million dollars. No unemployment, plant closures, or changes in industry production capacity are expected.

Generation of hazardous wastes subject to the Resource Conservation and Recovery Act (RCRA) may be as high as 23,000 metric tons per year.

EPA expects no significant changes in terms of air emissions, noise, or radiation.

SECTION II

RECOMMENDATIONS

Based on the findings of this study, EPA recommends that wastewater effluent limitations attainable through the application of best available technology economically achievable (BAT) rest on contract hauling to completely eliminate the discharge of pollutants from all ink manufacturing facilities.

Similarly, EPA recommends that standards of performance for new sources (NSPS) and pretreatment standards for new and existing sources (PSNS and PSES) eliminate pollutant discharges from ink manufacturing facilities.

SECTION III

INTRODUCTION

PURPOSE AND AUTHORITY

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," Section 101(a). By July 1, 1977, existing industrial dischargers were required to achieve "effluent limitations requiring the application of the best practicable control technology currently available" (BPT), Section 301(b)(1)(A); and by July 1, 1983, these dischargers were required to achieve "effluent limitations requiring the application of the best available technology economically achievable . . . which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants" (BAT), Section 301(b)(2)(A). New industrial direct dischargers were required to comply with Section 306 new source performance standards (NSPS), based on best available demonstrated technology; and new and existing dischargers to publicly owned treatment works (POTW) were subject to pretreatment standards under Sections 307(b) and (c) of the Act. While the requirements for direct dischargers were to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the Act, pretreatment standards were made enforceable directly against dischargers to POTW (indirect dischargers).

Although Section 402(a)(1) of the 1972 Act authorized the setting of requirements for direct dischargers on a case-by-case basis, Congress intended that, for the most part, control requirements would be based on regulations promulgated by the Administrator of EPA. Section 304(b) of the Act required the Administrator to promulgate regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of BPT and BAT. Moreover, Sections 304(c) and 306 of the Act required promulgation of regulations for NSPS, and Sections 304(f), 307(b), and 307(c) required promulgation of regulations for pretreatment standards. In addition to these regulations for designated industry categories, Section 307(a) of the Act required the Administrator to promulgate effluent standards applicable to all dischargers of toxic pollutants. Finally, Section 301(a) of the Act authorized the Administrator to prescribe any additional regulations "necessary to carry out his functions" under the Act.

The EPA was unable to promulgate many of these regulations by the dates contained in the Act. In 1976, EPA was sued by several environmental groups, and in settlement of this lawsuit EPA and the plaintiffs executed a "Settlement Agreement," which was approved by the Court. This Agreement required EPA to develop a program and adhere to a schedule for promulgating for 21 major industries BAT effluent limitations guidelines, pretreatment standards, and new source performance standards for 65 "priority" pollutants and classes of pollutants. See Natural Resources Defense Council, Inc. v. Train, 8 ERC 2120 (D.D.C. 1976), modified March 9, 1979.

On December 27, 1977, the President signed into law the Clean Water Act of 1977. Although this law makes several important changes in the federal water pollution control program, its most significant feature is its incorporation into the Act of several of the basic elements of the Settlement Agreement program for toxic pollution control. Sections 301(b)(2)(A) and 301(b) (2)(C) of the Act now require the achievement by July 1, 1984, of effluent limitations requiring application of BAT for "toxic" pollutants, including the 65 "priority" pollutants and classes of pollutants which Congress declared "toxic" under Section 307(a) of the Act. Likewise, EPA's programs for new source performance standards and pretreatment standards are now aimed principally at toxic pollutant controls. Moreover, to strengthen the toxics control program, Congress added Section 304(e) to the Act, authorizing the Administrator to prescribe "best management practices" (BMP) to prevent the release of toxic and hazardous pollutants from plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage associated with, or ancillary to, the manufacturing or treatment process.

In keeping with its emphasis on toxic pollutants, the Clean Water Act of 1977 also revised the control program for nontoxic pollutants. Instead of BAT for "conventional" pollutants identified under Section 304(a)(4) (including biochemical oxygen demand, suspended solids, fecal coliform, and pH), the new Section 301(b) (2)(E) requires achievement by July 1, 1984, of "effluent limitations requiring the application of the best conventional pollutant control technology" (BCT). The factors considered in assessing BCT for an industry include the costs of attaining a reduction in effluents and the effluent reduction benefits derived compared to the costs and effluent reduction benefits from the discharge of publicly owned treatment works (Section 304(b)(4)(B)). For nonconventional pollutants, Sections 301(b)(2)(A) and (b)(2)(F) require achievement of BAT effluent limitations within three years after their establishment or July 1, 1984, whichever is later, but not later than July 1, 1987.

The purpose of this report is to provide the technical data support for any BAT, BCT, or NSPS pretreatment standards for existing sources (PSES), and pretreatment standards for new sources (PSNS), which EPA may choose to issue for the unregulated segments of the ink industry, under Sections 301, 304, 306, 307 and 501 of the Clean Water Act.

SUMMARY OF METHODOLOGY

This document summarizes data concerned with wastewater generated by the ink industry. The initial task was to review previous EPA work on the industry; reports that provided background information included:

- "Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Oil-Base Solvent-Wash Subcategories of the Paint and Ink Formulating Point Source Category, (1975)" (1)

Prepared by the EPA National Field Investigation Center in Denver (NFIC-D), this document served as the basis for the July 28, 1975 regulations (40 CFR 447) that set forth no discharge for BPT, BAT, NSPS and New Source Pretreatment standards for the Oil-Base Solvent-Wash Subcategories. The information in this document was based on data provided by the East Bay Municipal Utilities District (EBMUD) of Oakland, California about several ink plant wastewaters.

- "Draft Development Document for Effluent Limitations Guidelines, Pretreatment Standards and New Source Performance Standards, Paint and Ink Formulating Point Source Categories, (1976)" (2)

Referred to as the "1976 study," this unreleased report provides additional detailed information related to wastewater management in those segments of the ink industry not covered by the July 28, 1975 no discharge regulations. The data presented in the 1976 report were based on a program of sampling and analysis at several ink plants, as well as on numerous plant visits and evaluations. Analytical data developed during this study were for conventional, nonconventional and inorganic toxic pollutants. Since this study was completed shortly after the Settlement Agreement between EPA and several environmental groups, EPA decided to incorporate this data with the required toxic pollutant study.

Review of these documents showed the need for additional information to profile the ink industry, as well as to properly quantify the impact of toxic pollutants as required by the Settlement Agreement.

Development of the needed information included the following tasks:

Industry survey;
Industry profile;
Wastewater sampling program;
Industry subcategorization;
Water use and wastewater characterization;
Selection of pollutant parameters;
Description of control and treatment technologies;
Cost data development.

First, EPA studied the ink formulating industry to determine whether differences in raw materials, final products, manufacturing processes, equipment, age and size of plants, water usage, wastewater constituents, or other factors required the development of separate effluent limitations and standards for different segments of the industry.

Next, EPA identified several distinct control and treatment technologies, including both in-plant and end-of-process technologies, which are in use, or capable of being used, in the ink formulating industry. The Agency compiled and analyzed historical data and newly generated data on the effluent quality resulting from the application of these technologies. The long term performance, operational limitations, and reliability of each of the treatment and control technologies were also identified. In addition, EPA considered the nonwater quality environmental impacts of these technologies, including impacts on air quality, solid waste generation, water scarcity, and energy requirements.

The Agency then estimated the costs of each control and treatment technology from unit cost curves developed by standard engineering analysis as applied to ink formulating wastewater characteristics. EPA derived unit process costs from model plant characteristics (production and flow) applied to each treatment process unit cost curve. These unit process costs were added to yield total cost at each treatment level. After confirming the reasonableness of this methodology by comparing EPA cost estimates to treatment system costs supplied by the industry, the Agency evaluated the economic impacts of these costs.

Upon consideration of these factors, as more fully described below, EPA identified various control and treatment technologies as BAT, PSES, PSNS, and NSPS. The proposed regulations, however, do not require the installation of any particular technology. Rather, they require achievement of effluent limitations representative of the proper operation of these technologies or equivalent technologies.

The ultimate goal of this work was to provide sufficient data for rulemaking in the unregulated segments of the ink industry. The remaining sections of this document discuss the results of each task in detail.

DATA AND INFORMATION GATHERING PROGRAM

EPA surveyed the ink formulating industry through the Data Collection Portfolio (DCP). This consisted of a questionnaire and some explanatory material and was intended to gather data for the unregulated segments of the ink industry.

The DCP form was divided into seven sections:

- General Information
- Plant Operations
- Production Characteristics
- Tank and Equipment Cleaning (representing a major wastewater source in many ink plants)
- Other Wastewater Sources
- Wastewater Handling and Disposal
- Raw Materials

This final format, as depicted in Appendix A, represents several stages of development, including review by members of the National Association of Printing Ink Manufacturers (NAPIM) and EPA.

Rather than attempting to contact a small but statistically valid sample of the ink industry, it was determined that through the use of computerized marketing information services virtually all ink manufacturing sites could be identified for receipt of a Data Collection Portfolio (DCP). In order to do this, a copy of the Dun and Bradstreet (D&B) "Dun's Market Identifiers" computer data tapes was obtained. On these tapes, general business information is recorded according to Standard Industrial Classification (SIC) for essentially all commercial establishments in the United States. For SIC 2893, Printing Ink, the D&B tapes utilized contain 567 entries.

The addresses of the 567 (SIC 2893) entries on the D&B tapes were used to form a preliminary mailing list. This list was reviewed by the National Association of Printing Ink Manufacturers (NAPIM). The NAPIM comments suggested certain additions and deletions to the mailing list yielding a final mailing list containing 598 entries. Additionally, representatives of major ink manufacturing firms were given the opportunity to review the mailing list. Six large companies indicated that the list did not adequately represent the number of small manufacturing sites and blending stations their firms operated. To resolve this, multiple blank portfolios were supplied to the corporate headquarters of the six firms requesting additional questionnaires.

This final mailing list was computerized and transferred to address labels to facilitate distribution. Each address was given a unique code number to assure that each response would be appropriately catalogued.

An additional complicating factor associated with the Ink Industry DCP was how to handle those captive ink producers that manufactured ink within a printing plant solely for use within that plant. Although strictly speaking these ink manufacturing operations are within SIC 2893, it was decided that it would be most efficient to survey the captive operations in conjunction with a parallel study of the

Printing Industry, SIC 27, being conducted by Environmental Science and Engineering Inc. Consequently the survey information gathered for the ink industry profile does not reflect the incremental impact of captive ink production on printing plant operations.

Response to the survey varied. Of the DCP's mailed out:

460 Portfolio questionnaires were returned and encoded on data tpaes

177 Portfolios were marked "Not a Manufacturing Site" indicating that the questionnaire was received by a corporate, or other site not involved in printing ink manufacture.

11 Portfolios were mailed to ink manufacturers who were no longer in business.

21 Portfolios were duplicates mailed to operating ink production plants.

23 Portfolios were undeliverable and returned.

All DCP respondents were instructed to answer survey questions pertaining to annual production or employment on the basis of their 1976 operations. For all other questions the respondents were directed to provide information on the basis of current operations. Consequently, the bulk of the survey information used in the following profile of the industry is based on plant operation during mid-1977.

GENERAL DESCRIPTION OF THE INDUSTRY

The variety of inks used today is broad, ranging from ordinary writing inks to specialized magnetic inks. A large volume of inks are specially produced for the printing industry and fall into four major categories. These four categories are: letterpress inks, lithographic inks, flexographic inks, and gravure inks.(3)

Letterpress inks are viscous tacky pastes using vehicles that are oil and varnish-based. They generally contain resins and dry by the oxidation of the vehicle.

Lithographic or off-set inks are viscous inks with a varnish-based vehicle, similar to the letterpress varnishes. The pigment content is higher in lithographic inks than letterpress ink because the ink is applied in thinner films. These inks are formulated to run in the presence of water since water is used to create the nonimage areas of the printing plate.

Flexographic inks are liquid inks which dry by evaporation, absorption into the substrate, and decomposition. There are two main types of flexographic inks: water and solvent. Water inks are used on absorbent paper and the solvent inks are used on nonabsorbent surfaces.

Gravure inks are liquid inks which dry by solvent evaporation. The inks have a variety of uses ranging from printing publications to food package printing.

Number of Manufacturing Sites and Employment

Total industry employment was placed at approximately 9,600 by the 1972 Commerce Department Census of Manufacturers, 5,700 of which were involved in production. Based on the DCP results, the number of employees involved in production during 1976 averaged approximately 9,000. Ink manufacturers produce many custom formulations, and tend to be geographically dispersed as are their customers. This and other factors, such as relatively low capital investment, accounts for the large number of small plants in the industry. Forty-two percent of the plants responding to the survey have less than ten employees, and 71 percent have under 20 employees. Six companies (Borden, Sun Chemical, Inmont Flint Ink, Kohl and Madden, and Sinclair and Valentine Division of Wheelabrator Frye) have 37 percent of all ink manufacturing plants and 13 companies account for 51 percent of all plants. A breakdown of the number of plants falling into size ranges according to the number of employees is presented in Table III-1.

Table III-2 summarizes some pertinent ink industry statistics as outlined in the 1972 Census of Manufacturers. According to the census, there were 407 ink establishments in 1972, up from 360 a decade earlier. Only 145 plants had over 20 employees. It should be noted that the census did not poll single establishment companies with less that ten employees, which represent a significant portion of the industry.

TABLE III-1

NUMBER OF PRODUCTION EMPLOYEES IN INK PLANTS (1976)

Number of Employees	Number of Plants	Percent of Total
0 - 10	195	42.4
11 - 20	133	28.9
21 - 30	59	12.8
31 - 40	26	5.7
41 - 50	14	3.0
51 - 60	3	0.7
61- 70	5	1.1
71 - 80	3	0.7
81 - 90	4	0.9
91 - 100	3	0.7
101 - 150	9	2.0
Over 150	4	0.9
No Data	2	0.4
Total	460	100%

Source: DCP

TABLE III-2

INK INDUSTRY PROFILE
1972 *Census of Manufacturers*

Number of Employees	Number of Plants	Percent of Plants	Value of Shipments ($ millions)	Percent of All Shipments
1 - 4	79	19.4	16.0	3.1
5 - 9	81	19.9	34.7	6.8
10 - 19	102	25.1	79.2	15.6
20 - 49	104	25.6	149.5	29.4
50 - 99	21	5.2	76.5	15.1
100 - 249	17	4.2	113.8	22.4
Over 250	3	0.7	38.6	7.6
Total	407	100%	508.3	100%

Source: 1972 Department of Commerce *Census of Manufacturers*

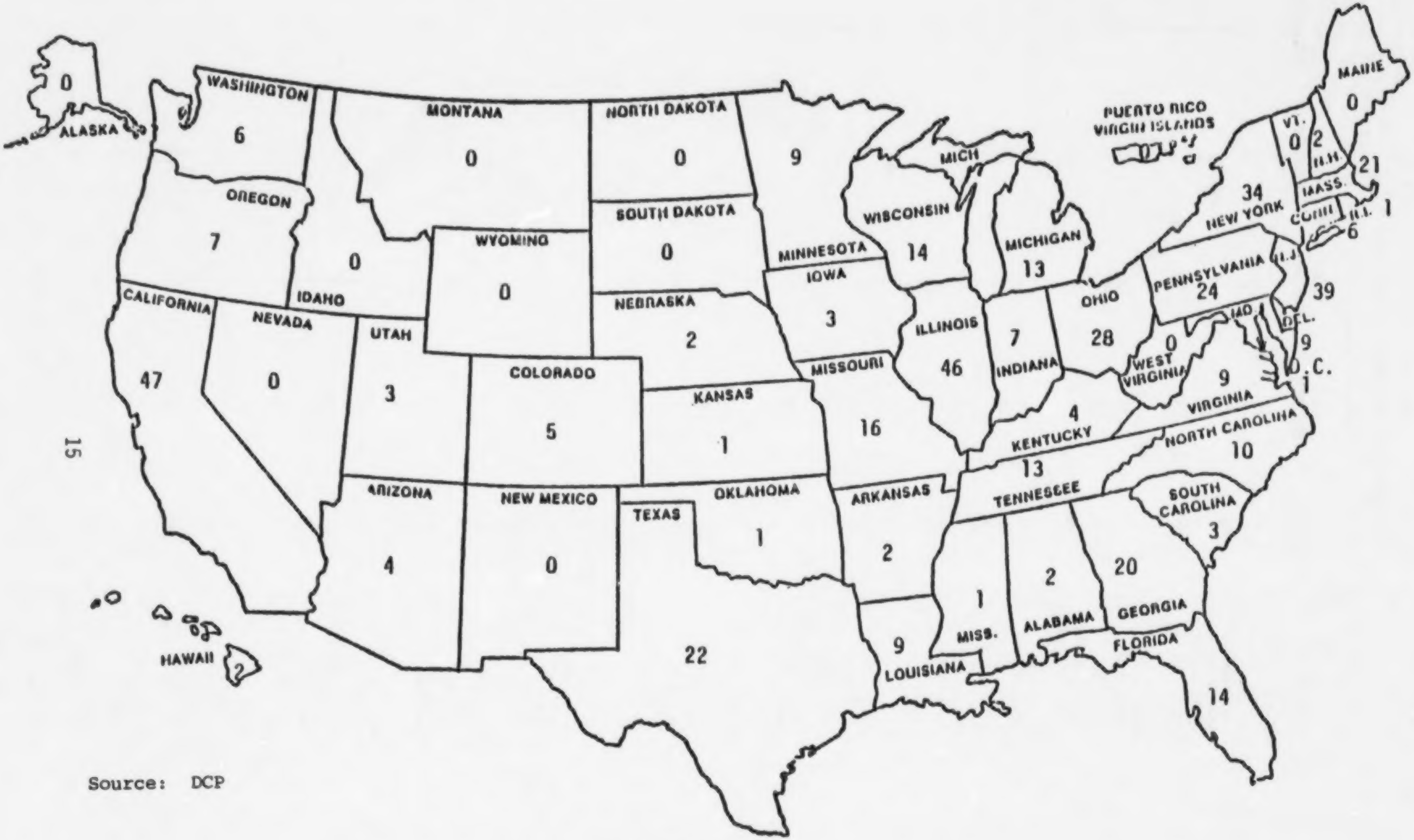
Ink Industry Sales

In 1972 the Census of Manufacturers estimated the total ink production to be over one billion pounds valued at $508 million. The products manufactured by the industry included letterpress inks (22 percent of dollar sales), lithographic inks (31 percent), gravure inks (17 percent), flexographic inks (15 percent), and other printing inks (15 percent). The single largest product of the ink industry is black ink for newspapers, which consists of finely ground carbon black in mineral oil. This ink is generally sold in bulk at low prices, while custom blended lightographic inks, frequently sold in batches (or kits) as small as 2.2 kg (five pounds), can cost ten times as much per unit weight. For a discussion on the types and properties of various printing inks, the Printing Ink Handbook(4) published by NAPIM is recommended.

Geographic Distribution of Ink Plants

The overall geographic distribution of ink plants is depicted in Figure III-1 and on Table III-3. Table III-4 shows that ink plants tend to be near population centers, due to transportation costs and the need to be near customers. Five states (California, Illionois, New Jersey, New York and Ohio) contain 194 plants or 42 percent of the 460 plants responding to the survey. Ten states have 65 percent of all ink plants and 21 states have 89 percent of all plants. Large ink plants tend to be concentrated in a relatively few states. Of the 130 ink plants with more than 20 employees, 52 percent are in just four states (California, Illinois, New Jersey, and Ohio), and 96 percent are in the 21 states listed on Table III-4. California, Illinois and Ohio have significantly higher proportions of large ink plants than expected relative to their total number of plants, while New York and Florida have a lower number of such plants than proprotional.

Production volume by state for the majority of states was not itemized by the Census Bureau because in many states one company accounts for a large percentage of production value. Production value by state, based on DCP data is also not presented, but California, Illinois, New Jersey, New York, and Ohio, account for over half of the ink manufactured in the United States.


ALASKA 0
WASHINGTON 6
OREGON 7
CALIFORNIA 47
IDAHO 0
NEVADA 0
MONTANA 0
WYOMING 0
UTAH 3
ARIZONA 4
COLORADO 5
NEW MEXICO 0
NORTH DAKOTA 0
SOUTH DAKOTA 0
NEBRASKA 2
KANSAS 1
OKLAHOMA 1
TEXAS 22
MINNESOTA 9
IOWA 3
MISSOURI 16
ARKANSAS 2
LOUISIANA 9
WISCONSIN 14
ILLINOIS 46
MICH
MICHIGAN 13
INDIANA 7
OHIO 28
KENTUCKY 4
TENNESSEE 13
MISS. 1
ALABAMA 2
GEORGIA 20
FLORIDA 14
SOUTH CAROLINA 3
NORTH CAROLINA 10
VIRGINIA 9
WEST VIRGINIA 0
PENNSYLVANIA 24
NEW YORK 34
N.J. 39
DEL. 9
MD.
D.C. 1
VT. 0
N.H. 2
MAINE 0
MASS. 21
CONN. 6
R.I. 1
PUERTO RICO VIRGIN ISLANDS
HAWAII 2

Source: DCP

FIGURE III-1
GEORGRAPHICAL DISTRIBUTION OF INK MANUFACTURING SITES

TABLE III-3

GEOGRAPHICAL DISTRIBUTION OF INK PLANTS

Number of Plants

EPA Region	Total	0-10 Employees	10-20 Employees	Over 30 Employees	Not Indicated
Region I					
Connecticut	6	5	1	0	0
Maine	0	0	0	0	0
Massachusetts	21	14	3	4	0
New Hampshire	2	1	0	1	0
Rhode Island	1	0	1	0	0
Vermont	0	0	0	0	0
Total	30	20	5	5	0
Region II					
New Jersey	39	14	10	15	0
New York	34	19	9	6	0
Puerto Rico	0	0	0	0	0
Virgin Islands	0	0	0	0	0
Total	73	33	19	21	0
Region III					
Delaware	0	0	0	0	0
D.C.	1	0	0	1	0
Maryland	9	5	2	2	0
Pennsylvania	24	9	6	9	0
Virginia	9	6	2	1	0
West Virginia	0	0	0	0	0
Total	43	20	10	13	0
Region IV					
Alabama	2	0	2	0	0
Florida	14	6	7	1	0
Georgia	20	7	7	6	0
Kentucky	4	1	2	1	0
Mississippi	1	1	0	0	0
North Carolina	10	6	2	2	0
South Carolina	3	2	1	0	0
Tennessee	13	6	6	1	0
Total	67	29	27	11	0
Region V					
Illinois	46	12	13	20	1
Indiana	7	1	1	5	0
Michigan	13	5	4	4	0
Minnesota	9	0	6	3	0
Ohio	28	9	6	13	0
Wisconsin	14	3	7	4	0
Total	117	30	37	49	1
Region VI					
Arkansas	2	1	1	0	0
Louisiana	9	7	2	0	0
New Mexico	0	0	0	0	0
Oklahoma	1	1	0	0	0
Texas	22	6	11	5	0
Total	34	15	14	5	0
Region VII					
Iowa	3	2	1	0	0
Kansas	1	1	0	0	0
Missouri	16	6	5	5	0
Nebraska	2	2	0	0	0
Total	22	11	6	5	0
Region VIII					
Colorado	5	4	1	0	0
Montana	0	0	0	0	0
North Dakota	0	0	0	0	0
South Dakota	0	0	0	0	0
Utah	3	3	0	0	0
Wyoming	0	0	0	0	0
Total	8	7	1	0	0
Region IX					
Arizona	4	3	0	0	1
California	47	21	7	19	0
Hawaii	2	2	0	0	0
Nevada	0	0	0	0	0
Total	53	26	7	19	1
Region X					
Alaska	0	0	0	0	0
Idaho	0	0	0	0	0
Oregon	7	2	4	1	0
Washington	6	2	3	1	0
Total	13	4	7	2	0
Accumulative Total	460	195	133	130	2

Source: DCP

TABLE III-4

DISTRIBUTION OF INK MANUFACTURING PLANTS BY STATE

State	Number of Plants	Percent of Plants	Number of Plants With over 20 employees	Percent of Total
California	47	10.2	19	14.4
Illinois	46	10.0	21	15.9
New Jersey	39	8.5	15	4.5
New York	34	7.4	6	4.5
Ohio	28	6.1	13	9.8
Pennsylvania	24	5.2	9	6.8
Texas	22	4.8	5	3.8
Massachusetts	21	4.6	4	3.0
Georgia	20	4.3	6	4.5
Missouri	16	3.5	5	3.8
Florida	14	3.0	1	0.8
Wisconsin	14	3.0	4	3.0
Michigan	13	2.8	4	3.0
Tennessee	13	2.8	1	0.8
North Carolina	10	2.2	2	1.5
Louisiana	9	2.0	0	0
Maryland	9	2.0	2	1.5
Minnesota	9	2.0	3	2.3
Virginia	9	2.0	1	0.8
Indiana	7	1.5	5	3.8
Oregon	7	1.5	1	0.8
All others	49	10.7	5	3.8

Source: DCP

Organization of Ink Plants

Of the DCP respondents, 28 percent indicated that they were the only manufacturing location for that company. Sixty-four percent of the plants are branch plants of a multiple plant company and six percent are divisions of a parent corporation. Less than two percent of the plants are captive manufacturing sites which produce ink solely for internal consumption. There are known to be approximately 100 captive ink manufacturing sites, but to avoid duplication, these plants received DCP's sent to the printing and publishing industry. Of the plants responding that they were branch plants, divisions or captive sites, almost 90 percent were set up as profit centers, while the remainder were cost centers. Forty-two percent, or 103 plant sites, are part of publicly held corporations and 54 percent, or 247 plants, are privately held. The remaining four percent of the industry falls under such other forms of organization as cooperative, partnerships, proprietorships, or did not answer the question on company organization.

Age Distribution of Ink Plants

Table III-5 breaks down the ink industry by the age of manufacturing facility. Half of the plants are between six and 20 years old, and the remaining plants are split almost equally into plants under six years old or over 20 years old. A cross tabulation of plant age and the number of employees (Appendix B) indicates that the plants with over 20 employees tend to be older facilities than the plants with under 20 employees.

Batch Sizes and Available Tankage

In the ink industry, the primary plant operation is the blending of various size batches of ink. Inks are often custom manufactured in batch sizes as small as 2.2 kilograms (5 pounds). Newspaper ink is commonly mass manufactured continuously or in large batches. In the DCP, plants were asked how many tubs they had in various sizes. Table III-6 presents a summary of production tub sizes used in the ink industry. EPA estimates the total available tankage for the industry to be 11,000 tubs, as indicated on Table III-7. Half of the tankage in the industry is less than 190 liters (50 gallons), accounting for about 12 percent of capacity. The majority of the industry's capacity is in tubs of 950 to 1900 liters (251 to 500 gallons). Large ink plants (those with over 20 employees) have approximately 50 percent of all tubs, and over 60 percent of total industry capacity, although they represent only 29 percent of all ink plants.

TABLE III-5

INK INDUSTRY BREAKDOWN BY AGE

Age	Number of Plants	Percent of Total
Less than 3 years	49	10.7
3 - 5 years	51	11.1
6 - 10 years	98	21.3
11 - 20 years	126	27.4
21 - 30 years	60	13.0
Over 30 years	64	13.9
Did not answer	12	2.6
Total	460	100%

Source: DCP

TABLE III-6

NUMBER OF INK PLANTS WITH TUBS OF VARIOUS SIZES

	Number of Tubs					
Tub Size	0	1-5	6-10	11-20	21-50	Over 50
	Number of Plants Responding					
Less than 5 gal.	123	72	45	46	9	5
6 - 10 gals.	123	65	45	31	7	5
10 - 50 gals.	41	119	94	78	30	8
51 - 100 gals.	54	107	96	61	17	4
101 - 250 gals.	118	104	45	20	10	0
251 - 500 gals.	162	54	12	11	6	2
501 - 1000 gals.	188	27	4	6	0	0
Over 1000 gals.	195	13	2	1	1	

Source: DCP

TABLE III-7

TOTAL INK INDUSTRY TANKAGE

Tub Size (gallons)	Number of Tubs	Percent of Total Capacity	Percent of Tubs In 132 Largest Plants*
Less than 5 gal.	1700	1%	30%
6 - 10 gals.	1300	1%	50%
11 - 50 gals.	3400	10%	50%
51 - 100 gals.	2600	20%	50%
101 - 250 gals.	1100	20%	60%
251 - 500 gals.	600	23%	80%
501 - 1000 gals.	200	15%	60%
Over 1000 gals.	100	10%	70%
Total	11,000	100%	

*Plants with over 20 employees

Source: DCP

Periods of Operation

The ink industry primarily functions on a one shift per day five day per week basis. Eighty-one percent of the plants responding to the DCP question concerned with shift operation indicated that they operate one shift per day, while 16 percent operate two shifts and only 3 percent operate three shifts. Almost 94 percent of the plants have eight-hour shifts, with the next most common shift lengths being seven hours and ten hours (2 percent each). Over 96 percent of the plants responding to the DCP operate five days per week, while 1 percent operate six days weekly and 2 percent indicate work weeks of under four days.

Most ink plants operate approximately 250 days per year. Forty-eight percent of the plants indicated that they work between 201 and 250 days per year and 44 percent work between 251 and 300 days. Of those giving the exact number of days, the four most common answers were 250, 253, 260, and 248 days per year. Three percent of the plants operate less than 200 days per year, and 4 percent operate over 300 days.

Production Characteristics

In the manufacture of inks, the three major ingredients, vehicles, pigments, and dryers, are mixed thoroughly together to form an even dispersion of pigments within the vehicle. The mixing is accomplished with the use of high-speed mixers, ball mills, three-roll mills, sand mills, shot mills, and/or colloid mills.

Most inks are made in a batch process in tubs ranging in sizes from 19 liters (five gallons) to over 3750 liters (1,000 gallons). The number of steps needed to complete the manufacture of the ink depends upon the dispersion characteristics of the ingredients. Most inks can be completely manufactured in one or two steps since many of the pigments used can be obtained predispersed in a paste or wetted form.

The pigments, vehicles, and additives are combined in calculated amounts into a mixing tub then blended in the commonly used high-speed vertical post mixers. The mixing speed used, determined by the nature of the ingredients, can range from a few revolutions per minute to several thousand revolutions per minute.

Many inks need additional dispersion to meet their formulation specifications. This is accomplished through further milling operations. A batch of ink may be put through the mills several times before the required dispersion is reached.

Data on total ink industry production appeared earlier in this Section. The following paragraphs discuss some of the production characteristics, analyses, statistics, and interrelationships of this data in more detail. Approximately half of the plants in the ink industry specialize in either paste ink or liquid ink. The other half produce both types of inks, with a wide variety of fractional mix. Table III-8 presents the data on production breakdown from all plants. The "average" plant, based on the average mix of all plants, produces 65 percent paste ink, and about 35 percent liquid ink.

Ink manufacturers can also be classified by their percentages of water-base ink and solvent-base or oil-base ink. Thirty-seven percent of the ink plants responding to the survey produce 100 percent solvent-base or oil-base ink, but only 3 percent of the plants produce 100 percent water-base ink. A breakdown of ink plants by the percent of water, solvent or oil-base ink manufactured is presented in Table III-9. The "average" plant produces approximately 60 percent oil-base ink, 25 percent solvent-base ink and 15 percent water-base ink. However, there are some differences between plants that produce exclusively solvent-base or oil-base ink and those that produce 100 percent water-base ink. These differences are depicted in Table III-10. Plants making exclusively solvent-base or oil-base ink produce mostly paste ink, while the plants dedicated to water-base ink products manufacture primarily liquid inks. Both groups of specialized plants are smaller in general than the industry average. Water-base ink plants, predictably rinse tubs with water more frequently and use a higher percentage of their total water consumption for this purpose.

Table III-11 summarizes the usage of organic and inorganic pigments in ink. This is important because many inorganic pigments contain heavy metals which are toxic pollutants. The survey data show that the industry relies on inorganic pigments for approximately 40 percent of total production, and organic pigments for 60 percent of production.

The data in Tables III-8, III-9 and III-10 are not necessarily consistent. This is because these tables represent responses to several DCP questions which were not answered consistently, nor were the answers to these questions necessarily mutually exclusive.

Raw Materials

The responses to DCP questions concerned with raw materials indicates that the production characteristic most strongly affecting the usage of toxic pollutants is the percentage of solvent-base ink and water-base ink production. To illustrate this trend for the industry as a whole, the percentage of solvent-base ink production was plotted against the percentage of plants using common toxic pollutants or classes of toxic pollutants (see Appendix D). For each plot, a least

TABLE III-8

PRODUCTION BREAKDOWN OF INK PLANTS

Paste Ink Production (Percent of Production Volume)	Percent of All Plants	Liquid Ink Production (Percent of Production Volume)	Percent of All Plants
0	13.0	0	39.1
1 - 10	2.4	1 - 10	8.0
11 - 20	5.9	11 - 20	3.0
21 - 30	4.3	21 - 30	2.8
31 - 40	3.3	31 - 40	2.6
41 - 50	9.6	41 - 50	6.5
51 - 60	3.3	51 - 60	7.2
61 - 70	2.8	61 - 70	3.3
71 - 80	3.0	71 - 80	4.8
81 - 90	3.5	81 - 90	4.3
91 - 99	8.3	91 - 99	2.2
100	38.7	100	12.2
Did not answer	2.0	Did not answer	3.9
Total	100%	Total	100%
Average	65%	Average	35%

Source: DCP

TABLE III-9

PRODUCTION BREAKDOWN OF INK PLANTS BY VEHICLE

Percent of Total Ink Production	Water-Base Ink	Solvent-Base Ink	Oil-Base Ink
	Percent of Responders		
0	44.1	48.0	14.1
1 - 10	23.9	7.0	3.7
11 - 20	5.9	3.3	6.7
21 - 30	4.3	4.1	4.3
31 - 40	4.3	4.6	4.3
41 - 50	3.9	10.0	7.6
51 - 60	2.0	2.6	3.5
61 - 70	1.1	2.4	3.0
81 - 90	0.7	3.0	3.5
91 - 99	2.0	2.8	10.7
100	2.6	4.8	32.4
Did not answer	4.1	5.0	2.6
Total	100%	100%	100%
Average	15	25	60

Source: DCP

TABLE III-10

COMPARISON OF PLANTS SPECIALIZING IN WATER-BASE AND SOLVENT/OIL-BASE INK

Comparison Parameter	Plants 100% Solvent-Base or 100% Oil-Base (171 Plants)	Plants 100% Water-Base (12 Plants)	All Plants (460 Plants)
		Percent of Plants	
Plants with over 20 Employees	20	8	29
Past Ink Production	85	30	65
Liquid Ink Production	15	70	35
Use Water for Tub Cleaning	4	15	7
Varnish Production	14	8	20
Water Rinse Used	15	75	34

Source: DCP

TABLE III-11

COMPARISON OF ORGANIC AND INORGANIC PIGMENTS USED IN INK PLANTS

Inorganic Pigment Usage (Percent of Production Volume)	Percent of Plants	Organic Pigment Usage (Percent of Production Volume)	Percent of Plants
0	7.0	0	4.1
1 - 10	25.4	1 - 10	5.7
11 - 20	7.4	11 - 20	6.5
21 - 30	7.2	21 - 30	5.7
31 - 40	4.6	31 - 40	5.0
41 - 50	12.4	41 - 50	15.0
51 - 60	7.6	51 - 60	3.7
61 - 70	5.2	61 - 70	5.4
71 - 80	4.1	71 - 80	7.4
81 - 90	4.1	81 - 90	7.6
91 - 99	3.7	91 - 99	21.5
100	3.0	100	6.3
Did not answer	8.3	Did not answer	6.1
Total	100%	Total	100%

Source: DCP

squares fit was calculated. The results of these calculations (slopes and correlation coefficients) are presented in Table III-12. For all but one major toxic pollutant, the slope of the best fit line is positive, indicating that the overall trend is for greater toxic pollutant usage with increased solvent-base ink production. The statistical validity of the fit was better for some of the toxic pollutants than for others as reflected in the higher R^2 or correlation coefficient. As can be seen from Table III-12, comparatively good fits were obtained for phenol, zinc, and lead.

TABLE III-12

SLOPES AND CORRELATION COEFFICIENTS FOR PLOTS OF PERCENT TOXIC POLLUTANT USAGE VERSUS PERCENT SOLVENT BASE INK PRODUCTION

Toxic Pollutant	Percent Solvent Base Ink Production	
	Slope	R^2
Dichlorobenzidene	.12	.14
Cyanide	.004	.00008
Zinc	.42	.67
Chromium	.064	.016
Chlorinated Organic Solvents	-.12	.04
Lead	.50	.64
Phthalates	.21	.13
Toluene	.38	.27
Phenol	.43	.46

Source: DCP

SECTION IV

INDUSTRY SUBCATEGORIZATION

INTRODUCTION

EPA considered the following factors in determining whether differences within the ink industry might require separate limitations.

1. Raw materials and products
2. Production methods
3. Size and age of production facilities
4. Wastewater characteristics
5. Tank or tub cleaning techniques

RATIONALE FOR SUBCATEGORIZATION

The Agency has concluded that tank or tub cleaning techniques offer an appropriate basis for subcategorization of the ink industry. The following two subcategories have been chosen.

1. Solvent-wash (solvent-base solvent-wash)

2. Caustic and/or water-wash

RAW MATERIALS AND PRODUCTS

Solvents, resins, extenders, pigments, and dispersing agents generally are similar for all ink products, except for the use of solvent or water as the dispersing medium. Raw materials and products are, therefore, not a basis for subcategorization, except as they influence tank or tub cleaning techniques.

PRODUCTION METHODS

Both solvent-base and water-base inks can be made in the same factory, with many of the same raw materials and in much of the same equipment. Some solvent-base pigments may be dispersed in roll or ball mills before blending into the dispersed calcium carbonate, talcs, and clays; these mills are generally not used for water-base inks. Because the production methods for all inks are quite similar, they are not a basis for subcategorization.

SIZE AND AGE OF PRODUCTION FACILITIES

This study showed that the size of production facilities affects only the volume of wastewater; the characteristics of the wastes are similar regardless of plant size. Because the ink manufacturing process equipment has not changed appreciably over the years, the age of the plant has little bearing on the waste characteristics. Therefore, neither size nor age of ink production facilities appear to be a valid basis for subcategorization.

WASTEWATER CONSTITUENTS

The untreated wastewaters generated by ink manufacturing operations contain a fairly diverse mixture of pollutants. These pollutants range from oxygen demand and solids to various toxic pollutants. Both water-base and solvent-base ink manufacturing wastewaters contain substantial quantities of these pollutants. No specific segment of the industry has a significantly different quality of wastewater. Consequently, wastewater constituents do not provide a good basis for subcategorization.

TUB CLEANING TECHNIQUES

The ink industry commonly uses three specific methods of ink tub cleaning. These cleaning methods include: (1) solvent-wash; (2) caustic-wash; and (3) water-wash. Solvent-wash is used exclusively to clean tubs used for formulating solvent-based and oil-based ink. When solvent-washing is used, essentially no wastewater is discharged. Caustic-wash techniques are used to clean both solvent-base and water-base ink manufacturing tanks. Water-washing techniques also are used in both the solvent-base and water-base segments of the ink industry. For solvent-base operations, water-washing usually only follows caustic-washing of solvent-base tanks. For water-base operations, water-washes often constitute the only tub cleaning operation. It should be noted, however, that periodic caustic cleaning of water-base ink tubs is also a common practice.

The treatability and disposal options for wastewater generated by water-wash and caustic-wash operations are essentially the same. Rinse waters generated following caustic-wash are sometimes less concentrated than exclusively water rinse generated wastewaters, although the pollutants contained in these two types of wastewater are similar. Consequently, the methods of treatment and disposal are alike. Furthermore, the quantity of wastewater generated by caustic-wash operations is not greater than that generated by water-wash techniques.

On the other hand, solvent-wash operations create significantly different waste streams. As a result, tub cleaning techniques appear to be a workable basis for subcategorization.

SECTION V

WATER USE AND WASTE CHARACTERISTICS

WATER USE

Water usage by ink plants responding to the DCP is shown on Table V-1. Based on these results EPA estimates daily water usage for the total industry between 3.7 and 21.6 million liters (1.1 - 5.7 mgd), with the most likely average falling between 7.6 and 11.4 million liters per day (2 - 3 mgd). Previous EPA studies of the ink industry have developed little data on water consumption, therefore no comparisons of historical data can be presented.

Water usage data for all ink plants also indicates that the highest proportion of water use is for cooling (50 percent), sanitary (27 percent), and product (9 percent). Other uses include boiler feed water (5 percent), tank and equipment cleaning (7 percent), air pollution control (1 percent), and miscellaneous (1 percent). The percentage of water used for various purposes does not differ substantially between small plants and large plants, as illustrated on Table V-2.

WASTEWATER SOURCES

Tub and Equipment Cleaning

Process wastewater from ink manufacturing plants results primarily from the rinsing of mixing tanks, roller mills and other equipment used for ink manufacture. Some additional wastewater may be contributed by floor and spill cleaning, laboratory and plant sinks, boiler and cooling water blowdown, air pollution control devices using water, and cleanout of raw material supply tank cars or trucks. Many ink plants segregate noncontact cooling water and sanitary wastewater for discharge to the sewer with no pretreatment.

Ink manufacture involves three basic steps; mixing of raw materials, milling, if required, and filling and packaging. In many plants, filling is done directly from the mill and no additional equipment is contacted by ink except some hand tools. Mixing tubs can be rinsed with either water, caustic, solvent, cleaned by dry methods, or by some combination of methods. Water rinses usually follow water-base ink batches, solvent rinses follow solvent or oil-base ink batches and caustic rinses follow either. Many plants routinely use caustic rinsing for small portable tubs and clean fixed tubs with caustic only when heavy build up of ink residue makes it necessary. The methods of tub rinsing practiced by ink plants according to DCP responses are presented on Table V-3.

TABLE V-1

TOTAL WATER USAGE BY THE INK INDUSTRY

Water Consumption	Number of Plants	Percent of Total
0 - 10,000 GPD	376	81.7
10,000 - 20,000 GPD	32	7.0
20,000 - 30,000 GPD	13	2.8
30,000 - 50,000 GPD	6	1.3
50,000 - 100,000 GPD	6	1.3
Over 10,000 GPD	0	0
Not Answered	27	5.9

Source: DCP

TABLE V-2

PERCENT WATER USAGE IN INK PLANTS

Use	Average of Plants With Less Than 10 Employees (195 Plants)	Average of Plants With 10-20 Employees (133 Plants)	Average of Plants With Over 20 Employees (130 Plants)	Average of All Plants
Used in Product	8	11	9	9
Cooling Water	49	58	49	50
Boiler Feed	3	3	7	5
Tub and Equipment Cleaning	6	6	7	7
Sanitary	31	21	26	27
Air Pollution Control	1	0	1	1
Other	2	1	1	1
Total	100	100	100	100

Source: DCP

TABLE V-3

METHODS OF TUB CLEANING USED BY INK PLANTS

Rinsing Method	Number of Plants	Percent of Total
Water Rinse only*	15	3.3
Solvent Rinse only*	176	38.3
Caustic Rinse or Soak only*	56	12.2
Dry Cleaning Only	25	5.4
Water and Caustic Rinse*	43	9.3
Water and Solvent Rinse*	64	13.9
Solvent and Caustic Rinse*	32	7.0
Water, Solvent and Caustic*	36	7.8
Not Answered	13	2.8
Total Using		
Water Rinse	158	34.3
Solvent Rinse	308	67.0
Caustic Rinse	111	24.1
Caustic Soak	85	18.5
Dry Clean Up	106	23.0

*With or without dry cleaning of tanks

Source: DCP

Solvent rinsing of solvent-base or oil-base ink tubs ordinarily generates no wastewater. The dirty solvent generally is handled in one of three ways:

1. used in the next compatible batch of ink as part of the vehicle;
2. collected and redistilled, either by the plant or by an outside contractor for subsequent resale or reuse; and
3. reused with or without settling to clean tubs and equipment until spent, and then drummed off for disposal. If sludge is settled out it is also drummed off for disposal by contract hauling.

Wastewater generated by rinsing tubs or equipment used for manufacturing water-base ink is usually handled in one of four ways:

1. reused in the next compatible batch of water-base ink as part of the vehicle;
2. reused either with or without treatment to clean tubs and equipment until spent. If sludge is settled out it is disposed by contract hauling;
3. discharged with or without treatment as wastewater; and
4. disposed of by contract hauling.

Plants using caustic rinse or washing systems usually rinse the caustic residue with water, although a few plants allow the caustic solution to evaporate in the tubs. There are several types of caustic systems commonly used by the ink industry. For periodic cleaning of fixed tubs two methods are most popular:

1. maintaining the caustic in a holding tank (usually heated) and pumping through fixed piping or flexible hose to the tub to be cleaned. Often a portable hood is placed over that tub, with nozzles to direct the spray. The caustic is returned to the holding tank; and
2. preparing the caustic solution in the tub to be cleaned, and soaking the tub until clean. The caustic solution is either transferred to the next tub to be cleaned, stored in drums or a tank for subsequent use, or is discarded.

For cleaning small portable tubs three common methods are used by the ink industry:

1. pumping caustic from a holding tank (usually heated) to nozzles in a fixed or portable hood which is placed over the tub to be cleaned. The caustic drains to a floor drain or sump and is pumped back to the tank, or is pumped back directly from the tub;
2. maintaining an open top caustic holding tank. Small tubs are put into "strainers" and dipped into these tanks until clean; and
3. placing the tubs in a "diswasher-like" device which circulates hot caustic and a subsequent water rinse. These devices can handle tubs up to about 1900 liters (500 gal).

The water rinse following a caustic-wash is rarely reused in a subsequent batch of ink. The most common methods for disposal of this rinse are:

1. recycling it back into the caustic as make-up water;
2. drumming it for contract hauling;
3. discharging it as wastewater, with or without pretreatment. Combination with other wastewater prior to treatment or disposal is sometimes practiced. Discharge of this wastewater is currently prohibited by some states and municipalities and may be prohibited in other areas in the future; and
4. discharge as a wastewater, with or without combination with other plant wastewaters or pretreatment.

Most caustic using plants recycle the caustic solution until it loses some of its cleaning ability. The caustic is then disposed of either by contract hauling or as a wastewater, with or without neutralization or other treatment. In the DCP, plants using caustic rinsing were asked to indicate whether their system was a closed loop system (all of the water rinse is used as caustic make-up), partial recycle, or open (no reuse of the water rinse). There was some confusion among responders regarding the definitions of the three terms. Sixty-five plants responded that they had a closed loop system. Telephone and field contact with a sample of these plants showed that while all of the plants recycled their caustic solution, few were able to recycle all of their water rinse. At least one manufacturer in the United States makes a true closed loop caustic system, but it is not widely used by the ink industry. Twenty-one plants responding to the survey recycled part of their caustic rinse water and 68 plants indicated no recycle of rinse water.

The Agency asked plants responding to the DCP to indicate how many gallons of water were used to clean tubs of various sizes. The results are presented in Table V-4, for that section of the industry indicating the use of water to clean tubs. For all tub sizes listed, the majority of plants used less than 38 liters (10 gal) to clean a tub after a batch of ink. The percentage of plants requiring over 38 liters (10 gal) to clean a mixing tub increases as expected, as the size of the tub increases. For tubs between 950 and 1900 liters (251 to 500 gal) the Agency estimates that the average water usage for cleaning falls between 45 and 114 liters (12 and 30 gal) with the most likely average between 57 and 76 liters (15 to 20 gal).

The amount of water generated by tub cleaning is influenced by the water pressure used. A cross-tabulation of water pressure by volume of water for each range of tub size is presented in Appendix C. These tables indicate some correlation between the two variables; plants with high pressure rinses tend to generate less tub cleaning wastewater per batch of ink.

Other Pollutant Sources

Beyond process wastewater generated from tub and equipment cleaning, there are other sources of pollutants within the typical ink plant. These wastewater streams must be considered in any water management schemes developed for the ink industry. The following are the most common sources of potentially contaminated wastewater found at ink manufacturing facilities, other than those discussed in the preceding section:

1. bad or spoiled ink batches which are not reworked or disposed of by contract hauling;
2. residue from spills, which are discharged to the sewer or combined with other wastewater;
3. contaminated storm water runoff;
4. wastewater from cleaning tank trucks delivering raw materials;
5. wastewater from plant or laboratory sinks used for rinsing hand equipment coated with ink or for disposal of small quantities of ink;
6. steam condensate from steam injection distillation of solvents used to clean ink tubs;
7. contact water from air pollution control devices; and

TABLE V-4

AMOUNT OF WATER USED TO CLEAN AN INK TUB

	Water Used Per Tub Cleaning					
Tub Size	0-5 gal.	6-10 gal.	11-50 gal.	51-100 gal.	Over 100 gal.	Total
			Percent of Plants Responding*			
Under 10 gal.	85.0	10.0	5.0	-	-	100%
1 - 50 gal.	60.3	26.7	11.2	1.7	-	100
51 - 100 gal.	44.4	29.6	23.1	1.9	0.9	100
101 - 250 gal.	30.5	24.4	40.2	4.9	-	100
251 - 500 gal.	41.2	23.5	23.5	7.8	3.9	100
501 - 1000 gal.	65.4	3.8	7.7	19.2	3.8	100
Over 1000 gal.	75.0	-	10.0	5.0	10.0	100

*Only plants indicating the use of a water rinse were considered (158 plants).

Source: DCP

8. wastewater from the laundering of rags which were used to clean ink tubs or equipment.

Other wastewater sources which do not contact the ink but which may contain conventional or nonconventional pollutants, such as BOD or TSS, include:

1. sanitary wastewater;

2. noncontact cooling water;

3. boiler blowdown; and

4. noncontact steam condensate

The DCP asked plants to indicate which of these wastewater sources were combined with tub cleaning wastewater before disposal. The three most common answers were sanitary wastewater, noncontact cooling water, and laboratory wastewater. As with water usage, sanitary wastewater and cooling water account for over 75 percent of the total wastewater stream at most ink plants, with tub cleaning wastes and boiler blowdown making the next largest contribution. Table V-5 presents the number of plants which generate various miscellaneous sources of wastewater.

WASTEWATER VOLUME

According to the DCP responses, the ink industry generates about 150,000 liters (40,000 gallons) of wastewater daily. Only 75 percent or 112,500 liters (30,000 gallons), as reported in the DCP responses actually is discharged, the remaining fraction being reused, evaporated or disposed of by contract hauling.

As is the typical trend in the ink industry, a few large plants generate most of the wastewater, while the many small plants account for just a few percent of the total flow. A follow-up with several larger ink plants, conducted by NAPIM, indicated that those plants contacted had overestimated the volume of wastewater discharged indicated on their DCP responses. NAPIM has stated that based on their follow-up, the total ink industry discharge should be adjusted to about 92,000 liters (24,300 gallons) daily.

Table V-6 presents the amount of process wastewater generated by all ink plants as reported in the DCP responses. Process wastewater for this study was defined as only that wastewater that has an opportunity to contact ink solids, such as tub wash water, caustic-wash rinse water, and floor wash water. Other wastewaters such as sanitary or noncontact cooling water were not considered part of the process

TABLE V-5

OTHER POLLUTION SOURCES

Source	Number of Plants Responding	Percent of All Plants
Wet Scrubbers	10	2
Boiler Blowdown or Cleaning	11	2
Laboratory	21	5
Steam Condensate	5	1
Solvent is Redistilled on Site	2	1
By Steam Injection Distillation	0	0
Spent Caustic is Discharged to Sanitary Sewer	43	9
Spent Solvent is Discharged to Sanitary Sewer	26	6

Source: DCP

TABLE V-6

WASTEWATER GENERATION BY THE INK INDUSTRY

Wastewater Generated (gpd)	All Plants Number of Plants	All Plants Percent of Total	Plants Using a Water Rinse Number of Plants	Plants Using a Water Rinse Percent of Total
0	171	37.2	12	7.6
1 - 100	171	37.2	97	61.4
101 - 250	33	7.2	23	14.6
251 - 500	12	2.6	7	4.4
500 - 750	6	1.3	5	3.2
751 - 1,000	5	1.1	1	0.6
Over 1,000*	12	2.6	7	4.4
Not Answered	50	10.9	6	3.8
Total	460	100.0	158	100.0

*Follow-up by NAPIM with this group of plants indicated that some responders included non-contact cooling water.

Source: DCP

wastewater stream, although a few plants may have mistakenly included these flows in their totals indicated on the DCP.

The most important factors affecting the volume of process wastewater generated and discharged at ink plants is the amount of solvent-base or oil-base ink versus water-base ink produced, and whether solvent rinsing or caustic rinsing of solvent-base ink is utilized. Table V-7 compares wastewater generation volumes between plants producing only water-base ink and plants producing solvent-base ink exclusively. As the table shows, most of the plants that generate no wastewater produce only solvent-base ink.

The volume of process wastewater discharged by the ink industry as a whole is shown on Table V-8. Fifty-two percent (237 plants) of the industry discharges no wastewater. Of plants that utilize a water rinse for cleaning tubs, 57 plants, (36 percent) practice "no discharge." Even among plants that produce 100 percent water-base ink (Table V-9), four plants (33 percent) discharge no wastewater. Of plants producing 100 percent oil-base or solvent-base ink, 87 plants (51 percent) discharge no wastewater. Of the plants that discharge wastewater (Table V-8), 84 plants (18 percent of the industry) discharge less than 380 liters per day (100 gpd).

WASTEWATER CHARACTERIZATION

The Agency assembled historical analytical data on the occurrence of conventional, nonconventional, and toxic pollutants in wastewater from the ink industry from the following sources:

1. the National Field Investigation Center - Denver (NFIC-D) Report (1975)(1);
2. historical data attached to DCP responses; and
3. municipalities and EPA regional offices.

Unfortunately, much of the historical data represents ink process wastewater combined with other wastewater sources, such as cooling water or sanitary wastewater, in undetermined ratios. Virtually all of the data obtained from municipalities and from the DCP's are in this form. These data are not directly comparable with sampling data from segregated ink process wastewater. The sources of historical analytical data are discussed in the following paragraphs.

In February 1975, NFIC published a Draft Development Document for Proposed Effluent Guidelines and New Source Performance Standards for the Paint and Ink Formulation Industries.

TABLE V-7

VOLUME OF WASTEWATER GENERATED BY INK PLANTS PRODUCING ONLY WATER-BASE, OIL-BASE, OR SOLVENT-BASE INK

Wastewater Generated (gpd)	Plants Producing 100% Water-Base Ink		Plants Producing 100% Oil-Base or Solvent-Base Ink	
	Number of Plants	Percent	Number of Plants	Percent
0	1	8.3	93	54.4
1 - 100	6	50.0	37	21.6
101 - 250	-	-	7	4.1
251 - 500	3	25.0	2	1.2
501 - 750	1	8.3	-	-
751 - 1,000	-	-	2	1.2
Over 1,000	-	-	2	1.2
Not Answered	1	8.3	63	13.7
Total	12	100.0	206	100.0

Source: DCP

TABLE V-8

WASTEWATER DISCHARGE BY THE INK INDUSTRY

Wastewater Discharged (gpd)	All Plants: Number of Plants	All Plants: Percent of Total	Plants Using Water Rinse: Number of Plants	Plants Using Water Rinse: Percent of Total
0	237	51.5	57	36.1
1 - 100	84	18.3	47	29.7
101 - 250	32	7.0	21	13.3
251 - 500	10	2.2	8	5.1
501 - 750	5	1.1	2	1.3
751 - 1,000	5	1.1	1	0.6
Over 1,000*	11	2.4	7	4.4
Not Answered	76	16.5	15	9.5
Total	460	100.0	158	100.0

*Follow-up by NAPIM with this group of plants indicated that some responders overestimated their discharge volume.

Source: DCP

TABLE V-9

VOLUME OF WASTEWATER DISCHARGED BY INK PLANTS PRODUCING ONLY WATER-BASE, OIL-BASE OR SOLVENT-BASE INKS

Wastewater Discharged (gpd)	Plants Producing 100% Water-Base Ink		Plants Producing 100% Oil-Base or Solvent-Base Ink	
	Number of Plants	Percent of Total	Number of Plants	Percent of Total
0	4	33.3	87	50.9
1 - 100	4	33.3	25	19.7
101 - 250	-	-	6	3.5
251 - 500	3	25.0	3	1.8
501 - 750	-	-	3	1.8
751 - 1,000	-	-	1	0.6
Over 1,000	-	-	2	1.2
Not Answered	1	8.3	44	25.7
Total	12	100.0	171	100.0

Source: DCP

This report was based, in part, on analytical data collected by the NFIC-Denver staff. This report served as the basis of the July 1975 Development Document recommending no discharge for the two subcategories, solvent-base/solvent-wash paint and solvent-base/solvent-wash ink. These regulations were subsequently promulgated for direct discharge plants only. The NFIC researched the untreated wastewater discharge of ink manufacturing sites in the Oakland, California area using the files of the East Bay Municipal Utilities District (EBMUD).

These results are presented in Table V-10. Some of EBMUD samples, however, appear to be from ink wastewater combined with other plant wastewater streams. To supplement these data, the NFIC collected two grab samples of the rinse from a caustic-washer. The results are found in Table V-11. For most parameters, the data from the two grab samples are at least an order of magnitude higher than the data from the EBMUD files.

Approximately 15 plants attached historical analytical data on wastewater discharged from their plants to their DCP's. All of the data characterized ink process wastewater combined with other wastewater streams. Consequently, none of the data submitted with the surveys is applicable.

SAMPLING DATA

Appendix H presents analytical data for conventional, nonconventional, and toxic pollutants from each of six ink plants where samples were collected during this study. The six selected plants covered a broad range of ink production. Some of the production characteristics of these plants, and their wastewater sources and treatment methods are presented in Tables V-12 and V-13. Three of the six plants treated wastewater prior to discharge, but only Plant 22 had sufficient wastewater volume to warrant sampling of both treated and untreated wastewater. Only untreated wastewater and intake water samples were collected at the other five plants. The information in Table V-12 came from interviews of plant personnel during plant visits supplemented by data from the DCP. The toxic pollutants that were potentially present in the raw materials from each ink plant are listed in Table V-14. This table was based on an analysis of the raw materials survey in the ink industry DCP.

A summary of the characteristics of untreated and treated wastewater, and tap water from the sampled ink plants is presented in Tables V-15 to V-17. Section VI discusses this information and its relationship to the raw materials survey. These tables summarize the number of times each conventional, nonconventional and toxic pollutant was analyzed for, the number of times each organic toxic pollutant was detected, and the number of times each was detected above 10 ug/l

TABLE V-10

CONSTITUENTS OF INK MANUFACTURING PLANT (SIC 2893) WASTES IN EAST BAY MUNICIPAL UTILITIES DISTRICT(1)

Constituent	No. of Entries	Values (mg/l)				
		Min.	Max.	Mean	Std.Dev.	Median
BOD	12	55	2,160	412	563	490
Total COD	16	310	3,270	926	693	935
Dissolved COD	16	170	2,980	742	643	876
Total Solids	2	338	385	361		-
Total Suspended Solids	16	13	1,230	156	292	78
Oil & Grease	14	7	183	57	49	97
Aluminum	2	0.5	1.8	1.1		-
Boron	2	0.18	0.21	0.19		-
Cobalt	1	0	0	0	0	0
Copper	1	0.06	0.06	0.06	0	0.06
Iron	2	0.6	2.2	1.4		-
Lead	2	0.26	0.32	0.29		-
Manganese	2	0.02	0.10	0.06		-
Nickel	2	0.01	0.01	0.01	0	0
Silver	2	0	0	0	0	0
Tin	2	0	0	0	0	0

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(1) All data from East Bay Municipal Utilities District files.

Source: NFIC-D Report

TABLE V-11

WASTE CHARACTERIZATION FROM AN INK TUB WASHER THAT RECYCLES THE WASH WATER (1)
(October 15-18, 1973)

Pollutant	Concentration (mg/l)
COD	59,500
TOC	32,000
Total Suspended Solids	31,600
pH	12.5 (2)
Metals	
Barium	6.7
Total Chromium	150
Cadmium	0.29
Iron	134
Lead	760
Zinc	4.9
Copper	6.4
Titanium	1

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(1) Survey conducted by NFIC-D; daily production 18,400 lb/day (average of data from two grab samples).

(2) Value reported as standard units.

Source: NFID-D Report

TABLE V-12

CHARACTERIZATION OF INK PLANTS PARTICIPATING IN THE 1977 SAMPLING PROGRAM(1)

	Ink Production		Pigments		Plant Uses Caustic Washer	Plant Practices Reuse	Wastewater Treatment		
Plant Code	% Water-Base	% Oil or Solvent-Base	% Organic	% Inorganic	Yes/No	Yes/No	Yes/No	Type	Major Wastewater Sources
7	30%	70%	60%	40%	No	Yes	No		WR
10	25%	75%(2)	35%	65%	Yes	Yes	Yes	GS	CR2
19	0	100%	5%	95%	Yes	No	No		CR2
21	35%	65%	15%	85%	No	Yes	No		WR, CR1,C
22	0	100%	65%	35%	Yes	No	Yes	GS,Neut.,SK,SC	CR1,CR2,ST
23	20%	80%	65%	35%	Yes	Yes	Yes	GS, SC	CR2

Type of Wastewater Treatment:

GS - Gravity Separation
Neut. - Neutralization
SK - Skimming
SC - Settling and Clarification

Major Wastewater Sources:

CR1 - Primary water rinse from caustic washer
CR2 - Secondary water rinse from caustic washer (primary rinse is recycled to caustic)
ST - Condensate from steam tub cleaner
C - Spent caustic
WR - Water rinse of ink tubs

(1) As of Sampling Period, 1977
(2) From DCP

Source: Interviews with plant personnel.

TABLE V-13

CHARACTERISTICS OF INK SAMPLING PLANTS

Plant Code	Production Type	Number of Employees	Wastewater Volume, gpd	Historical Data	Number of Toxic Pollutants
7	Liquid, mostly solvent	21-30	101-250	No	11
10	Heterogeneous	31-40	101-250	No	10
19	Speciality	31-40	101-250	Yes	21
21	Liquid, mostly solvent	41-50	251-500	Yes	6
22	Paste only	150+	1000+	Yes	9
23	Paste + Water Flexo	21-30	1-100	No	16

Source: DCP

TABLE V-14

TOXIC POLLUTANTS FOUND IN SAMPLING PLANT RAW MATERIALS

	7	10	19	21	22	23
Cadmium						X
Copper	X	X	X	X	X	X
Chromium	X	X	X	X	X	X
Lead	X	X	X	X	X	X
Nickel	X	X	X			X
Silver	X	X	X			X
Zinc		X	X		X	X
Phenol	X		X		X	X
Toluene	X	X	X		X	X
Ethylbenzene			X			X
Isophorone			X			X
di- (2-Ethylhexyl) Phthalate	X	X		X		X
Butylbenzyl Phthalate			X			
di-N-Butyl Phthalate			X			
Mercury						X
3-3' Dichlorobenzidine	X	X	X	X	X	X
Methyl Chloride			X			
Methylene Chloride			X			
Trichloroethylene			X			
Vinyl Chloride	X		X			
Vinylidine Chloride			X			

Source: DCP

TABLE V-15

UNTREATED WASTEWATER DATA SUMMARY
1977/1978 SAMPLING PROGRAM

PP	PARAMETER	NUMBER OF SAMPLES ANALYZED	NUMBER OF TIMES ABOVE DET. LIMIT	AVERAGE	MEDIAN	MINIMUM	MAXIMUM
	CONVENTIONAL POLLUTANT PARAMETERS						
	PH(UNITS)	9	9		9	6	13
	BOD(MG-L)	10	10	19804	5395	48	110000
	TOTAL SUSP. SOLIDS(MG-L)	10	10	991	740	93	2700
	NON-CONVENTIONAL POLLUTANTS						
	COD(MG-L)	10	10	39819	10350	190	270000
	TOC(MG-L)	10	10	9874	2260	46	66000
	OIL & GREASE(MG-L)	10	9	622	114	L 1	2400
	TOTAL SOLIDS(MG-L)	10	10	11351	4550	1100	51275
	TOTAL DISS. SOLIDS(MG-L)	9	9	11244	3600	980	51000
	TOTAL VOLATILE SOLIDS(MG-L)	9	9	10870	720	46	77500
	VOLATILE DISS. SOLIDS(MG-L)	8	8	11882	1255	137	77285
	TOTAL VOL. SUS. SOLIDS(MG-L)	8	8	341	257	53	1000
	ALUMINUM	11	9	40926	20000	L 500	300000
	BARIUM	11	11	19792	5520	200	120000
	IRON	11	8	29454	10000	L 900	200000
	MANGANESE	11	8	505	100	L 30	1530
	CALCIUM(MG-L)	11	5	962	L 50	L 25	10000
	MAGNESIUM(MG-L)	11	10	93	15	2	870
	BORON	10	4	553	L 500	L 300	1000
	COBALT	11	2	396	L 50	L 5	3110
	MOLYBDENUM	11	11	55990	1000	70	600000
	TIN	11	9	349	300	L 50	1000
	TITANIUM	11	8	1479	300	70	5500
	VANADIUM	11	2	131	L 100	L 12	600
	YTTRIUM	11	0	156	L 200	L 16	L 200
	SODIUM	11	10	2559	980	22	12200
	METAL PRIORITY POLLUTANTS						
114	ANTIMONY	11	3	613	L 25	L 25	2200
115	ARSENIC	11	0	384	L 25	L 25	L 2000
117	BERYLLIUM	11	0	8	L 10	L 1	L 10
118	CADMIUM	11	5	44	L 20	L 10	160
119	CHROMIUM	11	11	35271	20000	200	200000
120	COPPER	11	11	17138	900	100	100000
121	CYANIDE	10	7	161	L 105	L 1	540
122	LEAD	11	11	151009	50000	3000	900000
123	MERCURY	9	3	131	L 5	L 1	1100
124	NICKEL	11	2	261	L 50	L 20	2410
125	SELENIUM	11	0	384	L 25	L 25	L 2000
126	SILVER	11	1	8	L 10	4	L 10
127	THALLIUM	11	0	371	L 10	L 10	L 2000
128	ZINC	11	8	4080	2530	L 600	20000

TABLE V-15 (CON'T)

UNTREATED WASTEWATER DATA SUMMARY
1977/1978 SAMPLING PROGRAM

PP	PARAMETER	NUMBER OF SAMPLES ANALYZED	NUMBER OF TIMES DETECTED	NUMBER OF TIMES ABOVE 10 UG/L	AVERAGE	MEDIAN	MINIMUM	MAXIMUM
	ORGANIC PRIORITY POLLUTANTS							
1	ACENAPHTHENE	8	1	0	10 L	10 L	10 L	10
4	BENZENE	8	6	5	368	132 L	10	1600
6	CARBON TETRACHLORIDE	8	1	1	96	96	96	96
7	CHLOROBENZENE	8	2	2	278	278	27	530
8	1,2,4-TRICHLOROBENZENE	8	1	0	10 L	10 L	10 L	10
10	1,2-DICHLOROETHANE	8	2	1	89	89 L	10	169
11	1,1,1-TRICHLOROETHANE	8	2	2	560	560	120	1000
13	1,1-DICHLOROETHANE	8	2	2	21	21	10	33
14	1,1,2-TRICHLOROETHANE	8	1	0	10 L	10 L	10 L	10
21	2,4,6-TRICHLOROPHENOL	8	1	0	10 L	10 L	10 L	10
22	PARACHLOROMETA CRESOL	8	1	0	10 L	10 L	10 L	10
23	CHLOROFORM	8	4	2	37 L	14 L	10	110
25	1,2-DICHLOROBENZENE	8	2	0	10 L	10 L	10 L	10
29	1,1-DICHLOROETHYLENE	8	3	1	15 L	10 L	10	25
30	1,2-TRANS-DICHLOROETHYLENE	8	1	0	10 L	10 L	10 L	10
32	1,2-DICHLOROPROPANE	8	1	1	22	22	22	22
34	2,4-DIMETHYLPHENOL	8	1	0	10 L	10 L	10 L	10
35	2,4-DINITROTOLUENE	8	1	0	10 L	10 L	10 L	10
36	2,6-DINITROTOLUENE	8	1	0	10 L	10 L	10 L	10
37	1,2-DIPHENYLHYDRAZINE	8	2	1	3805 L	3805 L	10	7600
38	ETHYLBENZENE	8	3	3	4151	5500	254	6700
39	FLUORANTHENE	8	2	0	10 L	10 L	10 L	10
42	DI(2-CHLOROISOPROPYL) ETHER	8	1	0	10 L	10 L	10 L	10
44	METHYLENE CHLORIDE	8	5	5	950	180	26	2900
49	TRICHLOROFLUOROMETHANE	8	1	0	10 L	10 L	10 L	10
51	CHLORODIBROMOMETHANE	8	1	1	43	43	43	43
54	ISOPHORONE	8	1	1	44000	44000	44000	44000
55	NAPHTHALENE	8	4	3	16	15 L	10	23
62	N-NITROSODIPHENYLAMINE	8	1	0	10 L	10 L	10 L	10
64	PENTACHLOROPHENOL	8	2	1	655	655 L	10	1300
65	PHENOL	8	5	2	121 L	10 L	10	536
	TOTAL PHENOLS	10		10	235	98	28	700
66	DI(2-ETHYLHEXYL) PHTHALATE	8	7	3	12520 L	10 L	10	87000
67	BUTYL BENZYL PHTHALATE	8	1	0	10 L	10 L	10 L	10
68	DI-N-BUTYL PHTHALATE	8	6	3	188 L	41 L	10	770
69	DI-N-OCTYL PHTHALATE	8	1	1	3600	3600	3600	3600
70	DIETHYL PHTHALATE	8	1	1	25	25	25	25
71	DIMETHYL PHTHALATE	8	1	0	10 L	10 L	10 L	10
76	CHRYSENE	8	1	0	10 L	10 L	10 L	10
78	ANTHRACENE	8	3	1	12 L	10 L	10	16
80	FLUORENE	8	1	0	10 L	10 L	10 L	10
81	PHENANTHRENE	8	2	0	10 L	10 L	10 L	10
84	PYRENE	8	1	0	10 L	10 L	10 L	10
85	TETRACHLOROETHYLENE	8	5	5	1250	170	22	3100
86	TOLUENE	8	7	6	1617	580 L	10	6000
87	TRICHLOROETHYLENE	8	4	4	1841	1172	19	5000
90	DIELDRIN	8	1	0	10 L	10 L	10 L	10

ALL UNITS UG/L UNLESS OTHERWISE NOTED
PP-PRIORITY POLLUTANT NUMBER
L-LESS THAN

TABLE V-16

TREATED WASTEWATER DATA SUMMARY
1977/1978 SAMPLIMG PROGRAM

PP	PARAMETER	NUMBER OF		AVERAGE	MEDIAN	MINIMUM	MAXIMUM
		SAMPLES ANALYZED	TIMES ABOVE DET. LIMIT				
CONVENTIONAL POLLUTANT PARAMETERS							
	PH(UNITS)	2	2		13	13	13
	BOD(MG-L)	1	1	2600	2600	2600	2600
	TOTAL SUSP. SOLIDS(MG-L)	2	2	970	970	110	1830
NON-CONVENTIONAL POLLUTANTS							
	COD(MG-L)	2	2	5805	5805	4800	6810
	TOC(MG-L)	1	1	940	940	940	940
	OIL & GREASE(MG-L)	2	2	2822	2822	260	5384
	TOTAL SOLIDS(MG-L)	2	2	10465	10465	5600	15331
	TOTAL DISS. SOLIDS(MG-L)	1	1	5500	5500	5500	5500
	TOTAL VOLATILE SOLIDS(MG-L)	1	1	200	200	200	200
	VOLATILE DISS. SOLIDS(MG-L)	1	1	153	153	153	153
	TOTAL VOL. SUS. SOLIDS(MG-L)	1	1	47	47	47	47
	ALUMINUM	2	2	3655	3655	600	6710
	BARIUM	2	2	2060	2060	100	4020
	IRON	2	1	3130 L	3130 L	2000	4260
	MANGANESE	2	1	55 L	55 L	50	60
	CALCIUM(MG-L)	2	0	27 L	27 L	5 L	50
	MAGNESIUM(MG-L)	2	2	5	5	1	9
	BORON	1	0	500 L	500 L	500 L	500
	COBALT	2	1	360 L	360 L	50	670
	MOLYBDENUM	2	1	1145 L	1145 L	50	2240
	TIN	2	0	50 L	50 L	50 L	50
	TITANIUM	2	2	1725	1725	450	3000
	VANADIUM	2	0	110 L	110 L	100 L	120
	YTTRIUM	2	0	180 L	180 L	160 L	200
	SODIUM	2	2	407	407	364	450
METAL PRIORITY POLLUTANTS							
114	ANTIMONY	2	0	1012 L	1012 L	25 L	2000
115	ARSENIC	2	0	1012 L	1012 L	25 L	2000
117	BERYLLIUM	2	0	10 L	10 L	10 L	10
118	CADMIUM	2	0	20 L	20 L	20 L	20
119	CHROMIUM	2	1	2495 L	2495 L	50	4940
120	COPPER	2	1	1115 L	1115 L	60	2170
121	CYANIDE	2	2	665	665	30	1300
122	LEAD	2	1	16350 L	16350 L	200	32500
123	MERCURY	2	0	3 L	3 L	1 L	5
124	NICKEL	2	0	50 L	50 L	50 L	50
125	SELENIUM	2	0	1012 L	1012 L	25 L	2000
126	SILVER	2	0	10 L	10 L	10 L	10
127	THALLIUM	2	0	1005 L	1005 L	10 L	2000
128	ZINC	2	2	860	860	720	1000

TABLE V-16 (CON'T)

TREATED WASTEWATER DATA SUMMARY
1977/1978 SAMPLING PROGRAM

PP	PARAMETER	NUMBER OF			AVERAGE	MEDIAN	MINIMUM	MAXIMUM
		SAMPLES ANALYZED	TIMES DETECTED	TIMES ABOVE 10 UG/L				
	ORGANIC PRIORITY POLLUTANTS							
1	ACENAPHTHENE	2	1	0	10 L	10 L	10 L	10
4	BENZENE	1	1	1	96	96	96	96
28	3,3'-DICHLOROBENZIDINE	2	1	0	10 L	10 L	10 L	10
31	2,4-DICHLOROPHENOL	2	1	0	10 L	10 L	10 L	10
35	2,4-DINITROTOLUENE	2	1	0	10 L	10 L	10 L	10
38	ETHYLBENZENE	1	1	1	2400	2400	2400	2400
43	DI(2-CHLOROETHYOXY) METHANE	2	1	0	10 L	10 L	10 L	10
44	METHYLENE CHLORIDE	1	1	1	29	29	29	29
54	ISOPHORONE	2	1	1	46	46	46	46
55	NAPHTHALENE	2	2	1	60	60 L	10	110
65	PHENOL	2	1	1	18	18	18	18
	TOTAL PHENOLS	2		2	215	215	30	400
66	DI(2-ETHYLHEXYL) PHTHALATE	2	2	1	14	14 L	10	19
68	DI-N-BUTYL PHTHALATE	2	2	1	10	10 L	10	10
69	DI-N-OCTYL PHTHALATE	2	1	0	10 L	10 L	10 L	10
72	1,2-BENZANTHRACENE	2	1	0	10 L	10 L	10 L	10
78	ANTHRACENE	2	1	0	10 L	10 L	10 L	10
81	PHENANTHRENE	2	1	1	12	12	12	12
86	TOLUENE	1	1	1	1100	1100	1100	1100

ALL UNITS UG/L UNLESS OTHERWISE NOTED
PP-PRIORITY POLLUTANT NUMBER
L-LESS THAN

TABLE V-17

INTAKE (TAP) WATER DATA SUMMARY
1977/1978 SAMPLING PROGRAM

PP	PARAMETER	NUMBER OF SAMPLES ANALYZED	NUMBER OF TIMES ABOVE DET. LIMIT	AVERAGE		MEDIAN		MINIMUM		MAXIMUM
	CONVENTIONAL POLLUTANT PARAMETERS									
	PH(UNITS)	8	8			8		6		9
	BOD(MG-L)	7	0	2	L	2	L	2	L	2
	TOTAL SUSP. SOLIDS(MG-L)	7	6	3		4		1		6
	NON-CONVENTIONAL POLLUTANTS									
	COD(MG-L)	8	5	10	L	5		2		25
	TOC(MG-L)	7	7	8		7		2		13
	OIL & GREASE(MG-L)	8	3	1	L	1	L	1	L	5
	TOTAL SOLIDS(MG-L)	8	8	528		194		154		2305
	TOTAL DISS. SOLIDS(MG-L)	6	6	619		189		153		2299
	TOTAL VOLATILE SOLIDS(MG-L)	6	6	91		95		20		150
	VOLATILE DISS. SOLIDS(MG-L)	6	6	88		92		19		145
	TOTAL VOL. SUS. SOLIDS(MG-L)	6	6	2		2		1		5
	ALUMINUM	8	3	804		142	L	50		5000
	BARIUM	8	6	152		38	L	5		1000
	IRON	8	0	880	L	250	L	170	L	2000
	MANGANESE	8	3	28		28	L	5		60
	CALCIUM(MG-L)	8	5	90	L	50		29		120
	MAGNESIUM(MG-L)	8	8	14		11		3		38
	BORON	7	3	300		400	L	50	L	500
	COBALT	8	0	22	L	7	L	5	L	50
	MOLYBDENUM	8	5	306	L	15	L	5		2000
	TIN	8	5	66		35	L	5		300
	TITANIUM	8	1	100	L	25	L	15		300
	VANADIUM	8	1	46		20	L	10	L	100
	YTTRIUM	8	0	87	L	25	L	16	L	200
	SODIUM	8	3	346	L	56	L	15		2300
	METAL PRIORITY POLLUTANTS									
114	ANTIMONY	7	1	26	L	10	L	2	L	100
115	ARSENIC	7	0	21	L	25	L	2	L	25
117	BERYLLIUM	8	0	6	L	5	L	1	L	20
118	CADMIUM	8	1	9	L	5	L	2	L	20
119	CHROMIUM	8	6	279		21	L	5		2000
120	COPPER	8	6	87		47	L	6		300
121	CYANIDE	7	0	17	L	20	L	5	L	20
122	LEAD	8	6	2602		71	L	20		20000
123	MERCURY	6	2	2	L	1	L	1		6
124	NICKEL	8	1	24	L	13	L	5	L	50
125	SELENIUM	7	0	21	L	25	L	2	L	25
126	SILVER	8	1	5	L	3	L	1	L	10
127	THALLIUM	7	0	10	L	10	L	2	L	20
128	ZINC	8	2	303		225	L	60	L	600

TABLE V-17 (CON'T)

INTAKE (TAP) WATER DATA SUMMARY
1977/1978 SAMPLING PROGRAM

PP	PARAMETER	---NUMBER OF---			AVERAGE	MEDIAN	MINIMUM	MAXIMUM
		SAMPLES ANALYZED	TIMES DETECTED	TIMES ABOVE 10 UG/L				
	ORGANIC PRIORITY POLLUTANTS							
1	ACENAPHTHENE	8	1	0	10 L	10 L	10 L	10
4	BENZENE	8	5	4	50	40 L	10	135
8	1,2,4-TRICHLOROBENZENE	8	1	0	10 L	10 L	10 L	10
10	1,2-DICHLOROETHANE	8	1	0	10 L	10 L	10 L	10
11	1,1,1-TRICHLOROETHANE	8	1	0	10 L	10 L	10 L	10
15	1,1,2,2-TETRACHLOROETHANE	8	1	0	10 L	10 L	10 L	10
23	CHLOROFORM	8	6	4	106	49 L	10	350
25	1,2-DICHLOROBENZENE	8	1	0	10 L	10 L	10 L	10
40	4-CHLOROPHENYL PHENYL ETHER	8	1	1	40	40	40	40
44	METHYLENE CHLORIDE	8	7	7	154	63	25	408
48	DICHLOROBROMOMETHANE	8	3	3	41	23	15	87
49	TRICHLOROFLUOROMETHANE	8	1	0	10 L	10 L	10 L	10
51	CHLORODIBROMOMETHANE	8	2	1	42	42 L	10	74
54	ISOPHORONE	8	1	0	10 L	10 L	10 L	10
55	NAPHTHALENE	8	1	0	10 L	10 L	10 L	10
	TOTAL PHENOLS	8		3	14	19 L	2 L	20
66	DI(2-ETHYLHEXYL) PHTHALATE	8	4	3	67	47 L	10	164
67	BUTYL BENZYL PHTHALATE	8	2	0	10 L	10 L	10 L	10
68	DI-N-BUTYL PHTHALATE	8	4	1	15 L	10 L	10	33
70	DIETHYL PHTHALATE	8	1	0	10 L	10 L	10 L	10
74	3,4-BENZOFLUORANTHENE	8	1	0	10 L	10 L	10 L	10
78	ANTHRACENE	8	1	0	10 L	10 L	10 L	10
80	FLUORENE	8	1	0	10 L	10 L	10 L	10
81	PHENANTHRENE	8	1	0	10 L	10 L	10 L	10
86	TOLUENE	8	4	1	12 L	10 L	10	21
87	TRICHLOROETHYLENE	8	2	0	10 L	10 L	10 L	10
102	ALPHA-BHC	8	1	0	10 L	10 L	10 L	10
104	GAMMA-BHC	8	1	0	10 L	10 L	10 L	10

ALL UNITS UG/L UNLESS OTHERWISE NOTED
PP-PRIORITY POLLUTANT NUMBER
L-LESS THAN

(inorganic toxic pollutants and nonconventional pollutants had different detection limits, ranging from 0.5 ug/l to 2000 ug/l). The average (mean), median, minimum, and maximum values also are indicated. For many parameters in ink wastewaters, the average value is significantly higher than the median value. This is caused, partly, by the batch nature of ink manufacture. The infrequent use of any particular pigment containing a high level of a toxic pollutant may result in a large number of wastewater batches with a relatively low concentration of that pollutant, and a few wastewater batches with high levels. These high levels will proportionately influence the calculation of the average, and have a small effect on the computation of the median. In the tables that follow, pollutants which were never detected are not listed.

Table V-15 indicates the average untreated wastewater characteristics from the ink industry. A total of 60 toxic pollutants were detected at any level in one or more samples although only 10 toxic pollutants were measured at above 10 ug/l (or above their specific reported detection limit in the case of metals) in 50 percent or more of the samples. They were:

Toxic Pollutant	Percent of time measured above 10 ug/l (or other detection limit for metals)
Chromium	100%
Copper	100%
Lead	100%
Toluene	75%
Zinc	73%
Cyanide	70%
Tetrachloroethylene	63%
Methylene Chlorine	63%
Benzene	63%
Trichloroethylene	50%

An additional 12 toxic pollutants (chlorobenzene, 1,1,1-trichloroethane, 1,1-dichloroethane, chloroform, ethylbenzene, naphthalene, phenol, di(2-ethylhexyl) phthalate, di-n-butyl phthalate, antimony, cadmium, and mercury) measured above 10 ug/l (or the specific detection limit) in 25 to 50 percent of all samples.

A summary of wastewater characteristics from one ink plant after treatment is presented in Table V-16. Pollutant removal calculations will be presented in Section VII. A total of 32 toxic pollutants were reported in one or more treated ink effluent samples at any level. Only fifteen toxic pollutants measured above 10 ug/l (or above their specific reported detected limit in the case of metals) in 50 percent or more of the samples. These were:

Toxic Pollutant	Percent of time measured above 10 ug/l (or other detection limit for metals)
Benzene	100%
Ethylbenzene	100%
Methylene Chloride	100%
Toluene	100%
Cyanide	100%
Zinc	100%
Chromium	50%
Copper	50%
Lead	50%
Isophorone	50%
Naphthalene	50%
Phenol	50%
Di(2-ethylhexyl) phthalate	50%
Di-n-butyl phthalate	50%
Phenanthrene	50%

To properly gauge the effect of intake water on toxic pollutant occurrence, tap water was sampled at each ink plant. These data are presented in Table V-17. A total of 41 toxic pollutants were detected at any level in one or more samples. However, 18 of these were organic toxic pollutants that never measured above 10 ug/l. Only ten toxic pollutants measured over 10 ug/l (or their specific detection limit) in 25 percent or more of the samples. These were:

Toxic Pollutant	Percent of time measured above 10 ug/l (or other detection limit for metals)
Methylene Chloride	88%
Chromium	75%
Copper	75%
Lead	75%
Benzene	50%
Chloroform	50%
Dichlorobromomethane	38%
Di(2-ethylhexyl) phthalate	38%
Mercury	33%
Zinc	25%

Mass Loadings

As discussed previously in this section, according to DCP responses, the ink industry generates approximately 0.15 million liters (0.04 million gallons) of process wastewater daily, of which 0.113 million liters (30,000 gallons) is discharged. Table V-18 indicates the mass

TABLE V-18

UNTREATED WASTEWATER
MASS LOADING

PARAMETER	AVERAGE CONCENTRATION	KG/DAY	LBS/DAY
CONVENTIONAL POLLUTANT PARAMETERS			
BOD(MG-L)	19804	1796.	(3959.)
TOTAL SUSP. SOLIDS(MG-L)	991	90.	(198.)
TOTAL CONVENTIONAL POLLUTANTS	1890.0 KG/DAY(4160.0 LBS/DAY)		
NON-CONVENTIONAL POLLUTANTS			
COD(MG-L)	39819	3611.	(7961.)
TOC(MG-L)	9874	895.	(1974.)
OIL & GREASE(MG-L)	622	56.	(124.)
TOTAL SOLIDS(MG-L)	11351	1029.	(2269.)
TOTAL DISS. SOLIDS(MG-L)	11244	1020.	(2248.)
TOTAL VOLATILE SOLIDS(MG-L)	10870	986.	(2173.)
VOLATILE DISS. SOLIDS(MG-L)	11882	1077.	(2375.)
TOTAL VOL. SUS. SOLIDS(MG-L)	341	31.	(68.)
ALUMINUM	40926	3.711	(8.182)
BARIUM	19792	1.795	(3.957)
IRON	29454	2.671	(5.888)
MANGANESE	505	0.046	(0.101)
CALCIUM(MG-L)	962	87.	(192.)
MAGNESIUM(MG-L)	93	8.	(19.)
BORON	553	0.050	(0.111)
COBALT	396	0.036	(0.079)
MOLYBDENUM	55990	5.077	(11.194)
TIN	349	0.032	(0.070)
TITANIUM	1479	0.134	(0.296)
VANADIUM	131	0.012	(0.026)
YTTRIUM	156	0.014	(0.031)
SODIUM	2559	0.232	(0.512)
TOTAL NON-CONVENTIONAL POLLUTANTS	8810 KG/DAY(19400 LBS/DAY)		
METAL PRIORITY POLLUTANTS			
114 ANTIMONY	613	0.056	(0.123)
115 ARSENIC	384	0.035	(0.077)
117 BERYLLIUM	8	0.001	(0.002)
118 CADMIUM	44	0.004	(0.009)
119 CHROMIUM	35271	3.198	(7.051)
120 COPPER	17138	1.554	(3.426)
121 CYANIDE	161	0.015	(0.032)
122 LEAD	151009	13.694	(30.190)
123 MERCURY	131	0.012	(0.026)
124 NICKEL	261	0.024	(0.052)
125 SELENIUM	384	0.035	(0.077)
126 SILVER	8	0.001	(0.002)
127 THALLIUM	371	0.034	(0.074)
128 ZINC	4080	0.370	(0.816)
TOTAL METAL PRIORITY POLLUTANTS	19.0 KG/DAY(42.0 LBS/DAY)		

TABLE V-18 (CON'T)

UNTREATED WASTEWATER
MASS LOADING

PP	PARAMETER	AVERAGE CONC.	PERCENT OCCUR.	KG/DAY	LBS/DAY
	ORGANIC PRIORITY POLLUTANTS				
4	BENZENE	368	75	0.025	(0.055)
6	CARBON TETRACHLORIDE	96	12	0.001	(0.002)
7	CHLOROBENZENE	278	25	0.006	(0.014)
10	1,2-DICHLOROETHANE	89	25	0.002	(0.004)
11	1,1,1-TRICHLOROETHANE	560	25	0.013	(0.028)
23	CHLOROFORM	37	50	0.002	(0.004)
29	1,1-DICHLOROETHYLENE	15	37	0.001	(0.001)
38	ETHYLBENZENE	4151	37	0.139	(0.307)
44	METHYLENE CHLORIDE	950	62	0.053	(0.118)
51	CHLORODIBROMOMETHANE	43	12	0.000	(0.001)
54	ISOPHORONE	44000	12	0.479	(1.056)
55	NAPHTHALENE	16	50	0.001	(0.002)
64	PENTACHLOROPHENOL	655	25	0.015	(0.033)
65	PHENOL	121	62	0.007	(0.015)
	TOTAL PHENOLS	235		0.021	(0.047)
66	DI(2-ETHYLHEXYL) PHTHALATE	12520	87	0.988	(2.178)
68	DI-N-BUTYL PHTHALATE	188	75	0.013	(0.028)
69	DI-N-OCTYL PHTHALATE	3600	12	0.039	(0.086)
70	DIETHYL PHTHALATE	25	12	0.000	(0.001)
78	ANTHRACENE	12	37	0.000	(0.001)
85	TETRACHLOROETHYLENE	1250	62	0.070	(0.155)
86	TOLUENE	1617	87	0.128	(0.281)
87	TRICHLOROETHYLENE	1841	50	0.083	(0.184)

TOTAL ORGANIC PRIORITY POLLUTANTS 2.2 KG/DAY(4.8 LBS/DAY)

POLLUTANTS PRESENT AT LESS THAN 0.001 KG/DAY ARE NOT LISTED

AVERAGE CONCENTRATION IN UG/L UNLESS OTHERWISE NOTED.

loading from the ink industry for each conventional, nonconventional and toxic pollutant, based on an industry flow of 0.092 million liters (24,000 gallons) daily, and the average untreated wastewater characteristics from Table V-15. The effluent flow of 92,000 liters daily reflects comments made by NAPIM concerning the DCP responses to wastewater flow questions.

The ink industry discharges approximately 1900 kg/day (4200 lb/day) of conventional pollutants (BOD and TSS). The discharge of nonconventional pollutants is 8800 kg/day (19,400 lb/day); that of inorganic toxic pollutants is 19 kg/day (42 lb/day). The industry also discharges approximately 2.2 kg/day (4.8 lb/day) of organic pollutants. It should be noted, however, that different pollutant classes may count the same materials more than once. For example, some organic or inorganic toxic pollutants may be detected and counted by the analysis for BOD, COD, and/or solids.

Resampling

Most of the ink industry sampling was conducted between September 1977 and January 1978. During that time span EPA contract laboratories were badly overloaded, and consequently some of the samples were not extracted promptly, and some of the samples were not analyzed within the recommended time limits. To ascertain whether the subsequent analyses were accurate, the Agency chose two plants for resampling. During September 1978, one sample of untreated and treated wastewater and tap water was taken from one plant and untreated wastewater and tap water was taken from the second plant to compare with the old data. The untreated wastewater comparisons for conventional and toxic pollutants for these plants are presented in Table V-19. Both samplings showed general agreement for the presence or abscence of most organic toxic pollutants, although there was often a large difference in the quantitative value indicated. This is caused partly by the batch nature of ink manufacture and wastewater treatment, and partly by the essentially random selection of batches approximately one year apart. The inorganic toxic pollutants showed tendences similar to the organics.

TABLE V-19

RESULTS OF RESAMPLING AT TWO PLANTS
(One Year Interval)

Plant No.		7		22	
Batch		A	B	A	B
Conventional Pollutants:					
	pH	8.5	6	13	NR
	BOD (mg/l)	27,500	9,900	21,000	NR
	TSS (mg/l)	1,155	2,100	1,600	NR
Inorganic Toxic Pollutants:					
114	Antimony	1,275	L 2,000	L 25	L 2,000
115	Arsenic	L 25	L 2,000	L 25	L 2,000
117	Beryllium	L 10	L 1	L 10	L 10
118	Cadmium	30	19	90	160
119	Chromium	115,000	3,690	10,000	38,100
120	Copper	600	3,120	10,000	62,800
121	Cyanide	91	L 1	330	NR
122	Lead	120,000	14,100	90,000	150,000
123	Mercury	39	L 1	L 5	NR
124	Nickel	L 50	65	L 50	2,410
125	Selenium	L 25	L 2,000	L 25	L 2,000
126	Silver	L 10	4	L 10	L 10
127	Thallium	L 10	L 2,000	L 10	L 2,000
128	Zinc	3,000	2,550	1,000	2,530
Organic Toxic Pollutants					
1	Acenaphthene	-	L 10	-	ND
4	Benzene	45	L 10	-	220
6	Carbon tetrachloride	96	-	-	-
7	Chlorobenzene	-	27	-	530
8	1,2,4-Trichlorobenzene	-	L 10	-	-
10	1,2-Dichloroethane	-	169	L 10	-
11	1,1,1-Trichloroethane	-	1,000	-	-
13	1,1-Dichloroethane	-	33	-	-
21	1,4,6-Trichlorophenol	-	-	-	L 10
22	Parachlorometa Cresol	-	L 10	-	-
23	Chloroform	-	19	L 10	ND
25	1,2-Dichlorobenzene	-	L 10	-	-
29	1,1-Dichloroethylene	-	L 10	-	-
30	1,2-Trans-Dichloroethylene	-	L 10	-	-
32	1,2-Dichloropropane	-	22	-	
34	2,4-Dimethylphenol	-	L 10	-	-
35	2,4-Dinitrotoluene	-	L 10	-	ND
36	2,6-Dinitrotoluene	-	L 10	-	-
37	1,2-Diphenylhydrazine	-	L 10	7,600	-
38	Ethylbenzene	-	254	-	6,700
39	Fluoranthene	-	L 10	-	-
42	Di(2-chloroisopropyl) Ether	-	L 10	-	-
44	Methylene Chloride	ND	2,900	ND	45
49	Trichlorofluoromethane	-	L 10	-	-
51	Chlorodibromomethane	-	-	-	43
54	Isophorone	-	-	44,000	ND
55	Naphthalene	23	L 10	ND	17
62	N-nitrosodiphenylamine	-	L 10	-	-
64	Pentachlorophenol	-	-	-	L 10
65	Phenol	-	L 10	L 10	-
66	Di(2-ethylhexyl) Phthalate	510	L 10	L 10	L 10
67	Butyl benzyl Phthalate	-	ND	-	L 10
68	Di-N-butyl Phthalate	260	L 10	ND	L 10
70	Diethyl Phthalate	25	ND	-	-
71	Dimethyl Phthalate	-	L 10	-	L 10
72	1,2-Benzanthracene	-	-	-	L 10
78	Anthracene	-	L 10	-	ND
80	Fluorene	-	ND	-	L 10
81	Phenanthrene	L 10	ND	ND	-
84	Pyrene	-	L 10	-	-
85	Tetrachloroethylene	2,900	3,100	-	22
86	Toluene	-	6,000	L 10	3,000
87	Trichloroethylene	2,300	5,000	-	-
90	Dieldrin	-	L 10	-	-

A - First sample, fall 1977; B - Resampling, fall 1978.
All results are for untreated wastewater and are in ug/l unless otherwise noted.

Notes: Blanks or ND indicate not detected; NR indicates not run; L - less than.
Organic Toxic pollutants not listed indicate not detected or less than 10 for all six plants.

SECTION VI

SELECTION OF POLLUTANT PARAMETERS

INTRODUCTION

The purpose of the BAT review of the ink industry is to evaluate the occurrence and impact of toxic pollutants in the untreated, treated, and sludge streams generated within ink plants. The list of toxic pollutants, which represents the focus of the program, was developed as a result of the Settlement Agreement. Appendix A of the Settlement Agreement lists 65 classes of pollutants to be considered in the BAT revision for 21 industries, which EPA later expanded to 129 particular compounds. Appendix E presents 129 pollutants which represent the toxic, or "priority", pollutants addressed in this study.

The BAT review also included the evaluation of conventional and selected nonconventional pollutant parameters. The conventional parameters included in the study were pH, BOD, oil and grease, and total suspended solids (TSS). Nonconventional parameters included COD, and TOC.

In addition, a number of other nonconventional parameters were evaluated on an incidental basis either because their analysis had been included in ICP (Inductively Coupled Argon Plasma) multiple metal analysis (see Appendix I for a detailed explanation of this method) or because the parameter is an important element in ink manufacture or physical-chemical treatment of ink wastewater. These additional pollutants included aluminum, barium, boron, calcium, cobalt, iron, magnesium, manganese, molybdenum, sodium, tin, titanium, vanadium, and yttrium.

This section presents the techniques used to identify toxic pollutants in the ink industry.

METHODOLOGY

Prior to the various EPA studies of the ink industry, relatively little historical data had been developed for toxic pollutants. Some limited analyses of inorganic toxic pollutants had been completed, but for the most part historical data focused on conventional and nonconventional pollutants. The Agency established a three-step methodology to develop toxic pollutant data:

1. raw materials evaluation;
2. industry wide raw materials survey; and
3. screening sampling.

Raw Materials Evaluation

By studying the raw materials of the industry, EPA was able to establish information about the distribution of toxic pollutants in ink waste streams. This is a consequence of the way ink products are produced and ink wastewater is generated.

Ink is generally manufactured by blending raw materials; consequently, no thermodynamic changes occur (except for occasional heat of solution) and no by-products are formed. Instead, ink is made according to a predetermined formula or recipe without chemical reaction or change. Similarly, ink plant wastewater is generally produced in a straightforward way. When required, production tubs and other manufacturing vessels are washed clean of residue or clingage, using water, caustic or solvent. The spent cleaning material thus becomes laden with the material cleaned out of the tank, which, in turn, is composed of the raw materials making up the ink product. Determining the possible toxic pollutants in the waste streams is thus a matter of pinpointing the raw materials and toxic pollutants used in manufacturing ink.

There are four primary sources of ink industry raw materials information:

1. The National Paint and Coatings Association (NPCA) Raw Material Indexes (26, 27, 28);
2. Information supplied by raw materials vendors;
3. The Colour Index (9); and
4. The National Printing Ink Research Institute (NPIRI) Raw Materials Handbook (7, 8)

The Agency identified 39 toxic pollutants as constituents of raw materials used in ink manufacture. Table VI-1 lists those toxic pollutants that were identified, and their occurrence in ink raw materials.

Raw Materials Survey

The next step in ascertaining the extent of toxic pollutants in the ink industry was a survey of the industry to determine the use of specific raw materials associated with specific toxic pollutants. Section G, Raw Materials, of the Data Collection Portfolio (DCP) was designed to obtain this information and was organized according to the four broad areas of raw materials used in ink manufacture:

- Pigments and Dyes, Flushes and Dispersions;
- Chemical Specialties;
- Resins; and
- Solvents

TABLE VI-1

OCCURRENCE OF TOXIC POLLUTANTS IN INK RAW MATERIALS

Toxic Pollutant	Occurrence in Raw Materials			
	Pigments & Dyes	Chemical Specialties	Resins	Solvents
Antimony	X			
Cadmium	X			
Copper	X			
Chromium	X			
Lead	X	X		
Nickel	X	X		
Mercury		X		
Selenium	X			
Silver	X			
Zinc	X	X		
Phenols		X	X	
Benzene			X	X
Toluene			X	X
Ethylbenzene			X	X
Isophorone			X	X
di-(2-Ethylhexyl) Phthalate		X		
Butylbenzyl Phthalate		X		
di-N-Butyl Phthalate		X		
Dimethyl Phthalate		X		
Diethyl Phthalate		X		
3-3' Dichlorobenzidine	X			
Carbon Tetrachloride				X
Chloroform				X
Methyl Chloride			X	X
Methylene Chloride				X
Trichloroethylene			X	X
Vinyl Chloride			X	
Vinylidine Chloride			X	
1,2,4-Trichlorobenzene				X
1,2-Dichloroethane				X
1,1,1-Trichloroethane				X
1,1,2-Trichloroethane				X
Tetrachloroethylene				X
Chlorobenzene				X
1,3-Dichloropropylene				X
1,1-Dichloroethylene				X
Pentachlorophenol				X
1,2-Dichlorobenzene				X
di-(2-Chloroethyl) Ether				X

Sources: 7,8,9,26,27,28

Raw materials within these areas were grouped according to the occurrence of toxic pollutants. For example, all plasticizers containing diethyl phthalate, or all green aqueous dispersions containing chromium used in ink were grouped. Within each generic raw material designation, EPA listed the major manufacturers' trade names as an aid to respondents who might not be familiar with the chemical constituents of the raw materials in their products. Space also was provided so that respondents could indicate additional trade names for toxic pollutant-bearing raw materials used in their products.

The criteria for including raw materials in the DCP were:

1. The raw material itself is a solvent such as benzene, toluene or chemical specialties such as di-n-butyl phthalate or asbestos.

2. The raw material is known to contain toxic pollutants, i.e., white lead, zinc oxide, chrome orange, etc.

3. The raw material is commonly thinned with, or contains, toxic pollutants that are solvents, i.e., polyamids soluble in, or containing, toluene.

4. The raw material is synthesized from other raw materials that are toxic pollutants, i.e., dichlorobenzidine-derived aqueous dispersions.

Although for the last item listed above (raw materials synthesized from toxic pollutants) there is no firm evidence that the toxic pollutant is present in the raw material, these raw materials were included because of the possible carry over of small residues of the toxic pollutant.

Responses to the DCP indicated that 32 toxic pollutants identified in the literature review are used at one time or another in the ink industry. Since many of the raw materials included in the DCP can contain more than one toxic pollutant, the Agency was unable to obtain unambiguous counts for the occurrence of particular toxic pollutants. A conservative approach was taken because of this. When the DCP response did not indicate clearly which toxic pollutant was in use, the Agency made two counts - one including neither, one including both. This gave a maximum and minimum count for toxic pollutants. Fifteen plants did not check any boxes in the survey. It is not clear whether these responders use none of the listed raw materials or whether they did not fill out the questionnaire completely.

The range of plants using raw materials containing particular toxic pollutants appears in Table VI-2. The most common toxic pollutants found in ink raw materials are chromium, lead, toluene and phenol. Thirty-two of these toxic pollutants were indicated by at least one plant. Eight of the raw materials containing toxic pollutants were used by more than 100 plants, and 16 raw materials were used by at least 30 plants.

Sampling Program

EPA designed the sampling program to generate information that could characterize the nature, distribution, and concentration of toxic pollutants in ink wastewater. Further, the sampling program aimed to gather information about the efficiency of common end-of-pipe treatment systems not only to remove toxic pollutants, but to reduce the concentration of classical pollutants. Detailed information on sampling and analytical procedures used and specific data on samples collected are included in Appendix F.

In selecting sites for sampling, the Agency looked for ink manufacturing plants that were representative not only of industry production methods and product lines, but also of wastewater generation and treatment techniques. The following criteria were used in the selection process:

Plant Location

The logistics and costs of the anticipated sampling program required EPA to arrange multiple sampling visits within concentrated industrial zones. Table VI-3 summarizes the distribution of ink plants in major metropolitan areas. Ink plants located within these areas were given preference in the selection process.

Plant Size

Although very small plants outnumber others in the ink industry, the Agency decided not to sample at plants with less than ten production workers. The rationale for this decision was based on the fact that these ink plant operations do not differ significantly from the ink industry as a whole. Because ink manufacture is a batch process, using relatively small mixing vessels, small plants duplicate large plant operations precisely, differing only in scale. Plant inspection visits confirmed this.

TABLE VI-2
TOXIC POLLUTANTS FOUND IN RAW MATERIALS USED BY THE INK INDUSTRY

Toxic Pollutant	Responders Indicating Usage of Raw Materials Containing Specific Toxic Pollutants			
	Minimum		Maximum	
	No. of Plants	Percent	No. of Plants	Percent
Antimony	4	2.9	50	10.9
Cadmium	92	20	93	20.2
Copper	10	2.2	354	77.0
Chromium	325	70.7	377	82.0
Lead	256	55.7	400	87.0
Nickel	3	0.7	268	58.3
Selenium	2	0.	2	0.4
Silver	59	12.8	277	60.2
Zinc	151	32.8	159	34.6
Phenol	188	40.9	222	48.3
Mercury	2	0.4	2	0.4
Pentachlorophenol	8	1.7	8	1.7
Vinyl Chloride	93	20.2	93	20.2
3,3 -Dichlorobenzidine	393	85.4	393	85.4
Di-2 Ethylhexyl Phthalate	124	27.0	124	27.0
Di-N-butyl Phthalate	129	28.0	129	28.0
Dimethyl Phthalate	26	5.7	26	5.7
Diethyl Phthalate	34	7.4	34	7.4
Butyl Benzyl Phthalate	15	3.3	15	3.3
Benzene	9	2.0	9	2.0
Toluene	225	48.9	253	55.0
Ethylbenzene	33	7.2	33	7.2
Isophorone	30	6.5	30	6.5
Carbon Tetrachloride	1	0.2	1	0.2
1,1,1 Trichloroethane	41	8.9	41	8.9
1,1,2 Trichloroethane	1	0.2	1	0.2
Chloroform	1	0.2	1	0.2
1,2 Dichlorobenzene	1	0.2	1	0.2
Methylene Chloride	13	2.8	13	2.8
Trichloroethylene	32	7.0	67	14.6
Methyl Chloride	*	*	86	18.7
Tetrachloroethylene	14	3.0	14	3.0

*Minimum usage of methyl chloride could not be determined.

Source: DCP

TABLE VI-3

DISTRIBUTION OF INK PLANTS IN MAJOR METROPOLITAN AREAS

Metropolitan Area	Number of Ink Plants
New York/New Jersey	40
Chicago	44
Los Angeles	31
Atlanta	18
San Francisco	15
Dallas	14
Cleveland	11
St. Louis	10
Miami	7
Detroit	6
Houston	4
Louisville	4

Source: DCP

Wastewater Treatment

EPA made every effort to choose plants that operated end-of-pipe pipe wastewater treatment systems, and that encompassed all existing wastewater treatment types. Untreated wastewater loads at these plants were expected to be equivalent to untreated wastewater loads at similar plants without treatment.

A significant proportion (51 percent) of the DCP respondents indicated that they did not discharge any wastewater. These plants fit into several categories, including: plants using only solvent-wash, plants practicing complete wastewater reuse, and plants contract hauling all wastewater or spent caustic. Other plants indicated that they produced or discharged very little wastewater. As a result, in order for a plant to be selected for sampling, it would have to generate a reasonable volume of wastewater.

Some plants indicated that they had taken samples of their wastewater over a period of time, thus developing background on wastewater quality. Because this historical data could supply important substantiation, EPA tried to sample at these plants.

Toxic Pollutants

As previously stated, a goal of the raw materials survey was to provide information about the distribution of toxic pollutants in ink wastewaters. The survey established that 39 of the 129 toxic pollutants could be expected to occur at one time or another in ink wastewater. Consequently, in choosing sampling plants, the Agency tried to select operations that utilized raw materials containing a maximum number of toxic pollutants.

Direct Dischargers

EPA knew from the outset that practically no ink plants discharged process wastewaters; nevertheless, the Agency hoped to sample at least a few direct dischargers. Unfortunately, no ink plants discharging to navigable waters were located.

Selection of Sampling Sites

The sampling plant selection was accomplished in a step fashion. Initially, plants were selected if they had indicated on their questionnaires that they treat or condition their wastewater in some way before disposal. This selection yielded a preliminary list containing 23 ink plants. A supplementary selection of plants treating their wastewater before reuse yielded an additional 13 preliminary sampling site candidates.

Although the total of 35 sampling candidates derived from the above selection criteria would appear to have been sufficient for the purpose of selecting ink sampling plants, when the list was presented to NAPIM for their review and comments, several deficiencies were discovered. Perhaps the most serious drawback to the list was the fact that it did not adequately encompass the five major types of printing ink manufacturing plants:

- Exclusively paste ink
- Paste ink plus water flexo
- Liquid inks, mostly solvent
- Heterogeneous (broad paste and liquid product mix)
- Specialty (e.g., screen processes)

Additionally, it was suggested that the sampling program be limited only to those ink plants with more than twenty employees. As a result of these industry comments and suggestions, NAPIM volunteered to submit an alternate list of ink sampling plant candidates based on factors considered important by the industry, as well as including the five categories and having twenty or more employees. After extensive review, the NAPIM sampling list was eventually adopted as the basis for screening sampling. The list did not reflect either the geographic distribution of ink plants or the various types of end-of-pipe treatment in the industry. EPA concluded however, that the NAPIM list was at least as representative as the initial list and, in some respects, was more appropriate.

TOXIC POLLUTANTS

EPA grouped the toxic pollutants covered in this study according to the following components:

- Pesticides;
- Polychlorinated Biphenyls (PCB's);
- Phenolic Compounds;
- Volatile Organic Compounds;
- Semi-Volatile Organic Compounds; and
- Inorganic Compounds

The basis for this breakdown is chemical similarities and methods of analysis within each group. Each group's impact on ink wastewater is discussed in the following sections.

Pesticides and Metabolites

aldrin
dieldrin
chlordane (technical mixture and metabolites)
4,4' - DDT

4,4' - DDE (p,p'DDX)
4,4' - DDD (p,p'TDE)
a-endosulfan
b-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
a-BHC (hexachlorocylohexane)
b-BHC (hexachlorocylohexane)
c-BHC (hexachlorocylohexane)
d-BHC (hexachlorocylohexane)
toxaphene

Pesticides are not part of any raw materials used in ink manufacture. Occasional use of these materials in some ink plants for fumigation purposes has been reported. All occurrences of pesticides in ink wastewater samples were at less than 10 ug/l. Out of eight raw ink wastewater samples analyzed for pesticides, only dieldrin was found once at less than 10 ug/l. Two other pesticides, a-BHC and c-BHC, occurred at less than 10 ug/l once each in a tap water sample.

PCB's

None of the PCB mixtures included in the toxic pollutant listings were detected in any sample analyzed during this study. The raw materials evaluation similarly did not uncover any use of these materials in ink manufacture. However, it should be noted that specific PCB compounds may nevertheless be present in ink wastewaters.

The PCB's on the toxic pollutant list are actually mixtures of various PCB compounds ranging from monochlorobiphenyl to octochlorobiphenyl. As such, a positive identification of a PCB would require observation of a predetermined set of gas chromatogram peaks with appropriate relative intensities. However, various PCB's are formed during the synthesis of two types of pigments commonly used in ink manufacture: diarylide and phthalocyanine pigments. In Appendix E of the Dry Color Manufacturers Association comments regarding proposed rules for their industry (24), the following evaluation of PCB compounds in diarylide and phthalocyanine pigments was presented.

"For diarylide pigments, the source of the PCB's is 3,3'-dichlorbenzidene (sic), or its reaction product, which may undergo cleavage at the (biphenyl) carbon-to-nitrogen linkage to yield 3,3' dichlorbiphenyl (sic). Indeed, this has been identified as the PCB present in diarylide pigments. In the case of phthalocyanine the source of PCB is the trichlorbenzene (sic) (TCB) which has for many years been used as the solvent in the synthesis of the crude. TCB is not the only solvent which may be used, but it is the solvent which has been most widely used historically. It is believed that PCB's form by the elimination of hydrogen chloride, in the presence of copper, between two molecules of TCB. In the case of phthalocyanine blue, many different PCB's are present, since TCB is not a chemically pure material, and contains some amounts of dichloro and tetrachloro as well as trichlorobenzenes, and isomers of each in addition."

Phenolic Compounds

- phenol
- 2-chlorophenol
- 2,4-dichlorophenol
- p-chlorometa cresol
- 2,4-dimethylphenol
- 2,4,6-trichlorophenol
- 2-nitrophenol
- 4-nitrophenol
- 2,4-dinitrophenol
- 4,6-dinitro-o-cresol
- pentachlorophenol (PCP)
- total phenols

Only one phenolic toxic pollutant is used directly as a raw material in ink manufacture. That compound is pentachlorophenol (PCP) which is used as a preservative in some ink formulations. Approximately 1.7 percent of the respondents to the Data Collection Portfolio indicated that they used PCP. Other phenolic toxic pollutant compounds are not directly used in ink manufacture, but some occurrence of these materials was expected by virtue of the approximately 45 percent of the industry using phenolic resins.

PCP occurred in two of eight ink untreated wastewater samples (range, less than 10 to 1300 ug/l). Phenol also occurred frequently in ink wastewaters. Found in five of eight samples, untreated wastewater levels ranged from less than 10 to 536 ug/l. A single phenol measurement of 18 ug/l was reported in a treated effluent sample. Three other phenolic compounds, 2,4-dimethylphenol, 2,4,6-trichlorophenol and parachlorometacresol were found once in untreated wastewater samples at less than 10 ug/l. 2,4-dichlorophenol was found in one effluent sample, also at less than 10 ug/l.

Total phenols occurred frequently in all waste samples analyzed during the screening program. Raw wastewater total phenol ranged from less than 1 mg/l to 700 mg/l with an average of 235 mg/l. Treated effluent total phenol ran from 30 mg/l to 400 mg/l with an average of 215 mg/l.

Volatile Organic Toxic Pollutants

Halomethanes

- bromoform (tribromomethane)
- carbon tetrachloride (tetrachloromethane)
- chloroform (trichloromethane)
- chlorodibromomethane

dichlorodifluoromethane
dichlorobromomethane
methyl bromide (bromomethane)
methyl chloride (chloromethane)
methylene chloride (dichloromethane)
trichlorofluoromethane

Halomethanes, consisting of methane molecules with one or more hydrogen replaced by a halogen (chlorine, bromine, etc.) are used as solvents, aerosol propellants or for medicinal purposes. In the ink industry, only four of these pollutants, carbon tetrachloride, chloroform, methyl chloride, and methylene chloride were found to be raw materials (used as solvents).

Although only 0.2 percent of the DCP respondents indicated that they use chloroform, four of eight untreated wastewater samples were found to contain it (range, less than 10 to 110 ug/l; median, 14 ug/l). This is partially explained by the fact that nearly all (six of eight) tap water samples contained chloroform (range, less than 10 to 350 ug/l; median 49 ug/l).

Five of eight untreated wastewater samples, one treated wastewater sample, and seven of eight tap water samples were found to contain detectable quantities of methylene chloride. Although 2.8 percent of the DCP respondents indicated that they use methylene chloride, the frequent occurrence of this solvent may be misleading. This is because contamination of samples with methylene chloride has been reported as a common problem. This fact linked with the unusually high occurrence of methylene chloride compared to its use tends to reduce the impact of these data.

Of the remaining halomethanes, dichlorobromomethane did not occur in any untreated wastewater sample, but was found three times in tap water samples (median, 23 ug/l). Chlorodibromomethane was found in one untreated wastewater sample (43 ug/l) and in two tap water samples (median, 42 ug/l). Trichlorofluoromethane was found in one of eight untreated wastewater samples and one of eight tap water samples, both times at less than 10 ug/l. Carbon tetrachloride was measured in only one of nine untreated wastewater samples at 96 ug/l. The remaining halomethanes were not found in any samples collected during the screening program.

Chlorinated Ethanes

1,1-dichloroethane
1,2-dichloroethane
1,1,1-trichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane

chloroethane

Three of the six chlorinated ethanes which are primarily used as solvents were identified as being used in ink manufacture. The responses to the Data Collection Portfolio indicated that 1,1,1-trichloroethane, 1,2-dichloroethane and 1,1,2-trichloroethane are used at 8.9 percent, 0.2 percent and 0.2 percent of all ink manufacturing sites, respectively. Occurrence of these chlorinated ethanes in analyzed samples roughly followed this trend. 1,1,1-trichloroethane was detected in two of eight untreated wastewater samples (median, 560 ug/l). A single tap water sample contained 1,1,1-trichloroethane at less than 10 ug/l.

1,2-dichloroethane was detected in two of eight untreated wastewater samples (median, 89 ug/l), and in one of eight tap water samples at less than 10 ug/l. Similarly, 1,1-dichloroethane was found in two of the nine untreated wastewater samples (median, 21 ug/l) but it was not detected in any tap water sample. The only other occurrences of a chlorinated ethane were a single detection at less than 10 ug/l of 1,1,2-trichloroethane in a untreated wastewater sample and a single occurrence of 1,1,2,2 tetrachloroethane in a single tap water sample, also at less than 10 ug/l. The remaining chlorinated ethanes were absent from any analyzed sample.

Aromatic Solvents

benzene
toluene (methylbenzene)
ethylbenzene

The three aromatic solvents designated as toxic pollutants are common raw materials used throughout the ink industry, although some are used more extensively than others. These materials are not only used in ink formulations and as cutting solvents for resins used in ink, but also as a solvent for clean up.

Roughly 50 percent of all Data Collection Portfolio respondents indicated on the raw materials survey that they use toluene or toluene containing raw materials in their plants. The median toluene concentration in untreated wastes analyzed for aromatic solvents was 580 ug/l. The range was less than 10 ug/l to 6,000 ug/l. In total, seven of eight untreated wastewater samples contained toluene. Four of eight tap water samples contained toluene (range: less than 10 to 21 ug/l; median, less than 10 ug/l) and a single treated effluent sample contained 1,100 ug/l of toluene.

Ethylbenzene, used by 7.2 percent of the DCP respondents, was found in more than one-third of the untreated wastewater samples (median, 5,500 ug/l) and in one treated effluent samples (2,400 ug/l) but not in any tap water samples.

Benzene is not a frequently utilized aromatic solvent with only 2.0 percent of the DCP respondents indicating it on the raw materials survey. However, six of eight untreated wastewater samples were found to contain the solvent. The median untreated wastewater level was 132 ug/l with a range of less than 10 to 1,600 ug/l. Five of eight tap water samples contained this solvent (range, less than 10 to 135 ug/l; median, 40 ug/l), and it was found in a treated wastewater sample (96 ug/l).

Chloroalkyl Ethers

di (chloromethyl) ether
2-chloroethyl vinyl ether

These two materials which are used in pharmaceutical manufacture are not used in the ink industry, nor were they detected in any analyzed sample.

Dichloropropane and Dichloropropene

1,2-dichloropropane
1,3-dichloropropylene

Neither of these two solvents which are used as dry cleaning agents or soil fumigants were identified as raw materials used in the ink industry. However, 1,2-dichloropropane was found in one untreated wastewater sample at 22 ug/l, but not in any other analyzed sample.

Chlorinated Ethylenes

vinyl chloride
1,1-dichloroethylene
1,2-trans-dichloroethylene
trichloroethylene
tetrachloroethylene

Tetrachloroethylene is a common solvent used as a degreaser or dry cleaning fluid. Identified by 3.0 percent of the DCP respondents as in use at their plants, five of eight untreated wastewater samples contained tetrachloroethylene (median, 170 ug/l). No tap water or treated effluent samples contained the solvent.

Trichloroethylene is used by about 10 percent of the DCP respondents. Four of eight untreated wastewater samples were found to contain the solvent (median, 1,172 ug/l) and two tap water samples contained it both times at less than 10 ug/l. Although not identified as an ink raw material, 1,2-trans-dichloroethylene was found in one untreated wastewater sample at less than 10 ug/l but not in any other analyzed sample. Similarly, 1,1-dichloroethylene which is not an ink raw material was found in ink untreated wastewater. Three of eight untreated wastewater samples contained 1,1-dichloroethylene (range, less than 10 to 25 ug/l; median, less than 10 ug/l). No tap water or treated effluent samples contained this solvent.

Vinyl chloride was expected to occur in ink wastewater by virtue of the fact that about 20 percent of the DCP respondents indicated that they use polyvinylchloride (PVC) resins. Although vinyl chloride is the monomer used in polymerization of PVC, no ink wastewater samples were found to contain this toxic pollutant.

Miscellaneous Volatile Organics

acrolein
acrylonitrile
chlorobenzene

Neither acrolein nor acrylonitrile were identified as raw materials used in the ink industry. Both of these pollutants were found to be absent from any analyzed samples.

Chlorobenzene is a chemical intermediate used in production of phenol, aniline and DDT. Although not used as an ink raw material, chlorobenzene was found in two of eight untreated wastewater samples (27 and 530 ug/l) but not in any other analyzed samples.

Semi-Volatile Organic Toxic Pollutants

Polynuclear Aromatics (PNA's)

acenaphthene
acenaphthylene
anthracene
1,2-benzanthracene
3,4-benzofluoranthene
11,12-benzofluoranthene
3,4-benzopyrene
1,12-benzoperylene
crysene
1,2,5,6-dibenzanthracene
fluorene
fluoranthene
indeno-(1,2,3-cd) pyrene
naphthalene
phenanthrene
pyrene

With the exception of naphthalene, no significant incidence of polynuclear aromatics was found in ink wastewater nor are any of these materials used as raw materials in the industry.

Naphthalene was detected in four of eight untreated wastewater samples (range: less than 10 ug/l to 23 ug/l; median: 15 ug/l). Similarly, both effluent samples contained naphthalene (less than 10 and 110 ug/l) and it was found in one tap water sample at less than 10 ug/l.

The following PNA's occurred once in ink untreated wastewater at less than 10 ug/l: acenaphthene, chrysene, fluorene, and pyrene. Phenanthrene and fluoranthene occurred twice at less than 10 ug/l in untreated wastewater. Phenanthrene, acenaphthene, anthracene, fluorene, and 3,4-benzofluoranthene all occurred once in tap water at less than 10 ug/l. Single treated wastewater samples contained less than 10 ug/l of acenaphthene, 1,2 benzanthracene and anthracene. Phenanthrene was measured in one effluent sample at 12 ug/l. Finally anthracene was found in three of eight untreated wastewater samples (range: less than 10 to 16 ug/l).

Chlorobenzenes

1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
1,2,4-trichlorobenzene
hexachlorobenzene

No DCP respondent indicated use of any of the chlorobenzenes listed above. Two of the chlorobenzenes occurred in ink raw waterwater: 1,2-dichlorobenzene twice and 1,2,4-trichlorobenzene once, always at less than 10 ug/l. 1,2-dichlorobenzene occurred once in tap water, at less than 10 ug/l. One tap water sample also contained 1,2,4-trichlorobenzene at below the detection limit.

Phthalate Esters

di (2-ethylhexyl) phthalate
butyl benzyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate

Phthalate esters are synthetic compounds used primarily as plasticizers. In the ink industry, several phthalate esters were indicated as in use by varying percentages of DCP respondents: di (2-ethylhexyl) phthalate, 27 percent; di-n-butyl phthalate, 20 percent;

dimethyl phthalate, 5.7 percent; diethyl phthalate, 7.4 percent. All of the phthalate ester toxic pollutants were detected at least once during the screening sampling program. As indicated by the DCP responses, di (2-ethylhexyl) phthalate and di-n-butyl phthalate occurred most frequently in ink wastewater. The first of these, di (2-ethylhexyl) phthalate was found in seven of eight untreated waste samples (range, less than 10 ug/l to 87,000 ug/l). Di (2-ethylhexyl) was also found in both treated effluent samples (less than 10 and 19 ug/l) and in four of eight tap water samples (range: less than 10 to 164 ug/l; median: 47 ug/l).

Di-n-butyl phthalate was found in six of eight untreated wastewater samples. The concentration range in these samples was between less than 10 ug/l to 770 ug/l. Both treated wastewater samples contained di-n-butyl phthalate at less than 10 ug/l. Four of eight tap water samples contained di-n-butyl phthalate, both also at less than 10 ug/l. Four other phthalate esters occurred in ink untreated wastewater: butyl benzyl phthalate (once at less than 10 ug/l) dimethyl phthalate (once at less than 10 ug/l), and diethyl phthalate (once at 25 ug/l). A relatively high measurement for di-n-octyl phthalate of 3,600 ug/l in a single untreated wastewater sample was reported.

Di-n-octyl phthalate was found in one effluent sample at less than 10 ug/l and diethyl phthalate was detected in one tap water sample, also at less than 10 ug/l.

Since automatic samplers were used at roughly half of the plants where samples were collected, phthalate ester contamination is a possibility. However, phthalate esters were present in grab samples which did not come into contact with any material that might leach a phthalate ester contaminant.

Haloethers

di (2-chloroethyl) ether
di (2-chloroisopropyl) ether
di (2-chloroethoxy) methane
4-bromophenyl phenyl ether
4-chlorophenyl phenyl ether

The haloethers are synthetically produced chemical intermediates that are sometimes used as solvents. None of the haloethers were identified as in use as raw materials in the ink industry. Single occurrences at less than 10 ug/l of di (2-chloroisopropyl) ether and di (2-chloroethyoxy) methane were found in raw and treated wastewaters, respectively. 4-chloroephenyl phenyl ether was measured in one tap water sample at 40 ug/l.

Nitrosamines

N-nitrosodimethylamine
N-nitrosodiphenylamine
N-nitrosodi-n-propylamine

No incidence of nitrosamine toxic pollutants in ink raw materials has been found in the literature. N-nitrosodiphenylamine was found once at less than 10 ug/l in a untreated wastewater sample. No other incidence of a nitrosamine in an analyzed sample was reported.

Nitro-Substituted Aromatics Other than Phenols

nitrobenzene
2,4-dinitrotoluene
2,6-dinitrotoluene

Dinitrotoluenes are chemical intermediates used in the production of TNT. No evidence of the use of these compounds in ink manufacture was found during the raw materials evaluations. However, both nitrotoluenes were found once in untreated wastewater samples at less than 10 ug/l. A single treated effluent sample contained 2,4-dinitrotoluene at less than 10 ug/l.

Nitrobenzene was not identified as an ink raw material nor was it detected in any analyzed sample.

Benzidine Compounds

benzidine
3,3'-dichlorobenzidine

Benzidine compounds are used primarily in the manufacture of dyes. Benzidine itself was not identified as an ink raw material nor was it detected in any samples. However, 3,3'-dichlorobenzidine was identified as a raw material used in the manufacture of many pigments and dyes used in ink. Additionally, about 85 percent of the DCP respondents said they use dichlorobenzidine derived dyes or pigments. Although it was suspected that this material might carry over as a contaminant in pigments or dyes used in ink, it was only found in one treated effluent sample at less than 10 ug/l.

Miscellaneous Semi-Volatile Organic Toxic Pollutants

1,2 diphenylhydrazine
hexachloroethane
hexachlorobutadiene
hexachlorocyclopentadiene
2-chloronaphthalene

isophorone
2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

These materials are used primarily as solvents or chemical intermediates. TCDD is a by-product produced during the synthesis of the pesticide 2,4,5-T. Of the miscellaneous semi-volatile organics, only one, isophorone was identified as in use in ink manufacturing operations. Used as a solvent, 6.5 percent of the DCP respondents indicated isophorone on the raw materials survey. Isophorone was found in one of eight untreated wastewater samples (44,000 ug/l), one of two treated effluent samples (46 ug/l) and in one of eight tap water samples at below 10 ug/l.

Although not identified as a raw material, 1,2 diphenylhydrazine was found in two untreated wastewater samples (less than 10 and 7,600 ug/l).

Inorganic Toxic Pollutants

antimony
arsenic
asbestos
beryllium
cadmium
chromium
copper
cyanide
lead
mercury
nickel
selenium
silver
thallium
zinc

No asbestos or asbestos containing raw materials were identified as in use in any ink manufacturing plant. Coupled with the high costs of asbestos analysis, no samples were collected or analyzed for asbestos.

Four inorganic toxic pollutants, chromium, copper, lead, and zinc were found to be both contained in commonly used raw materials and to occur at relatively high concentrations in ink wastewater. For each of these toxic pollutants, average untreated wastewater concentrations were above 1,000 ug/l. The average antimony concentration in untreated wastewater was about 600 ug/l.

Some of the remaining inorganic toxic pollutants are contained in common ink raw materials, but none of the untreated wastewater samples were found to contain average concentrations greater than 400 ug/l for any of these pollutants.

Conventional Pollutant Parameters

Four conventional pollutant parameters (BOD, TSS, oil and grease, and pH) were measured in ink wastewaters collected during the sampling program. BOD concentrations averaged 19,800 mg/l in untreated ink wastewaters and 2,600 mg/l in treated wastewaters. For TSS, the average untreated wastewater and treated wastewater concentrations were 990 mg/l and 970 mg/l, respectively. The average oil and grease concentration was 622 mg/l while the median pH value in untreated ink wastewater samples was 9.

Nonconventional Pollutant Parameters

Among the nonconventional pollutant parameters analyzed during the screening program, a number of materials and reagents used in ink manufacture and ink wastewater treatment were measured. Elements found in ink wastewater treatment that were measured included aluminum, calcium, iron and sodium. Average untreated wastewater concentrations for these elements ranged between 2.6 and 962 mg/l. Other inorganic nonconventional pollutant average influent concentrations ranged between 130 ug/l to a high of 93 mg/l for magnesium. COD was measured at 39,800 mg/l in untreated ink wastewaters and 5800 mg/l in treated wastewaters.

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

The majority of ink plants that discharge wastewater discharge to municipal sewage systems. Frequently, ink process wastewater is diluted before discharge with cooling water, sanitary wastewater or other waste streams. Generally, the low flows from most ink plants coupled with this dilution have diminished the impact of ink wastewater on POTW. Consequently, few ink plants have been required by municipalities to pretreat their wastewater, and few plants have any type of wastewater treatment system.

IN-PLANT WASTEWATER CONTROL STRATEGIES

Ink plants use two general strategies to reduce the amount of wastewater discharged to the environment. The first is to reduce the amount of wastewater generated, and the second to reuse as much wastewater as possible within plant processes. The amount of wastewater generated is influenced by the water pressure used for tub and equipment cleaning, the degree of cleaning required, and the use of dry cleaning techniques. Some of these factors have been discussed in Section V (see Table V-4).

Wastewater Reduction

Some ink plants already utilize methods to reduce overall water usage. The amount of water required to clean large ink tubs can be reduced by cleaning the tub surfaces with a squeegee prior to rinsing. Small tubs can be partially or completely cleaned with rags. The quantity of wastewater from tub cleaning can also be reduced by the use of high pressure water. There are several commercial systems available which consist of booster pumps, flow regulators and nozzles; these supply low volume, high pressure water sprays which clean tubs as well or better than hand-held hoses using city water pressure, in a shorter time, with less water. As presented in Section V, the information from DCP responses indicates that there is a correlation between water pressure and the amount of water required for tub cleaning. This cross tabulation is shown in Appendix C.

A typical cleaning procedure for large ink tubs consists of using a garden hose with 40 to 60 psi water for a ten minute rinse of a 15,000 liter (4,000 gallon) mixing tub. This method can generate up to 1,100 liters (300 gallons) of wastewater. The use of a high pressure (1200 to 1500 psi), low volume (19 liters per minute) spray system on the same tub after it has been scraped clean of excess ink generates only 110 to 190 liters (30 to 50 gallons) of water. The lower volume of wastewater will also have a higher solids content, which facilitates eventual solids recovery. The basic equipment for a high pressure low volume wash system includes: a 19 liter per minute (5 gal/m) pump, one inch piping, high pressure hoses, nozzles, and the necessary fittings and connectors. The cost of such a system for ink plants is detailed in Section VIII. A spray pressure of 1200 to 1500 psi achieves the maximum cleaning efficiency while still maintaining a margin of safety for plant personnel. Hand-held wand nozzles, as well as large fixed whirling nozzles, are both available for tub cleaning. The wand nozzles also can be adapted for other cleaning operations within a plant. A permanent high pressure wash system with enough outlets to service the whole production area can be installed at very large ink plants. Smaller plants can use portable high pressure pumps with flexible hoses that can be moved from spot to spot.

Another in-plant control measure already used by ink plants to reduce wastewater generation is the sealing or elimination of floor drains and trenches. Plants that have no drains must collect all tub rinse water (unless it is piped to the treatment system or disposal point), which may encourage them to reduce the volume of water used for each purpose. Spills must be picked up with shovels or squeegees; floors usually are mopped, vacuumed or cleaned by machine. Where floor trenches exist, there is a greater tendency to hose down equipment and floors, leading to greater water consumption and wastewater generation.

Wastewater Recycle

Ink plants vary considerably in their tub cleaning practices and their willingness or reluctance to recycle wastewater. Of the DCP respondents , 158 plants indicated that they used a water rinse. An analysis of the tub cleaning and wastewater recycle procedures used by these plants is presented in Table VII-1. Of this group, 60 percent of the plants usually clean their tubs between batches, and 11 percent of the plants usually reuse their wastewater in subsequent batches of ink. There are no differences in reuse practices between small plants and large plants, as shown on Table VII-1.

Ink plants that practice caustic rinsing of tanks also can recycle some of their rinse water. As discussed in Section V, most caustic rinse systems recycle the caustic cleaning solution. The subsequent water rinse should be reused to the greatest extent possible to make up caustic solution lost by evaporation. Package caustic cleaning systems that incorporate complete or partial recycle of rinse water are available from various vendors. High pressure rinses following caustic cleaning reduce wastewater generation.

TABLE VII-1

FREQUENCY OF TANK CLEANING AND REUSE OF INK WASTEWATER

	All Plants Using Water Rinse	Plants Producing 100% Water-Base	Plants with Under 10 emp. Using Water Rinse	Plants with Over 20 emp. Using Water Rinse
	Percent of Plants			
Frequency of Tub Cleaning Between Batches				
Always	10.8	25.0	10.0	8.5
Most of time	48.7	33.3	35.0	62.7
Occasionally	38.6	33.3	53.3	28.8
Never	0.6	0	1.7	0
Not Answered	1.3	8.3	0	0
Reuse in Product				
Always	5.1	0	5.0	5.1
Most of time	5.7	0	6.7	6.8
Occasionally	16.5	8.3	10.0	16.6
Never	68.4	66.7	73.3	67.8
Not Answered	4.4	25	5.0	1.7
Reuse as Rinsewater				
Always	8.2	8.3	3.3	15.3
Most of time	17.7	8.3	15.0	22.0
Occasionally	19.0	8.3	13.3	22.0
Never	48.1	50.0	60.0	37.3
Not Answered	7.0	25.0	8.3	3.4

Source: DCP

Wastewater Disposal

Almost all ink plants that discharge process wastewater are indirect dischargers. The disposal methods used by ink plants for their wastewater are presented on Table VII-2. The most common methods are discharge to a sewer, contract hauling, evaporation and landfill or impoundment. Only four plants indicated discharging ink process wastewater directly to a receiving stream. Follow-up with these plants, however, showed that actually none were direct dischargers. Several respondents had misinterpreted the questions, and others discharged only noncontact cooling water. Thirteen ink plants indicated that they discharge process wastewater to a storm sewer, which can be considered a method of direct discharge. However, follow-up with all 13 plants determined that all of the plants either misinterpreted the question on the survey or discharged only noncontact cooling water to the storm sewer. In summary, there are no known plants that manufacture ink that discharge process wastewater directly to a receiving stream.

Altogether, 155 ink plants discharge all of their wastewater and/or spent caustic sludges by means of contract hauling, landfilling, or impoundment on plant property. Most contract haulers discharge the sludge to a landfill, although a small number incinerate or reclaim it. Thirty-one percent of all ink plants did not know what the contract hauler does with their waste.

Another potential source of waste from the ink industry is off-specification ink batches or other nonsuitable or returned product. Most plants attempt to rework this ink into other products to save as much of the raw materials as possible. Other plants sell or give the material to scavengers for reclaiming, or sell the ink at reduced prices as a lower quality material. This waste source usually is not discharged as a wastewater.

Some ink plants dispose of their wastewater by evaporation. Forced evaporation may be a wastewater disposal alternative for plants with no other viable choices. Forced evaporation requires high inputs of energy, and may require extensive air pollution control devices. Ink wastewater with high solids contents may coat heat exchanger surfaces and reduce operating efficiency. However, where excess steam is available, this process may be economically comparable to other disposal methods. This method also results in a significant residue or sludge stream which requires contract hauling.

WASTEWATER TREATMENT

The most common methods used by ink plants for treating or pretreating wastewater prior to disposal are gravity separation or settling, and neutralization. Wastewater treatment is practiced by less than 15

TABLE VII-2

WASTEWATER DISPOSAL METHODS

	All Plants		Plants Using Water Rinse	
Disposal Method*	Number of Plants	Percent of Total	Number of Plants	Percent of Total
Complete Reuse	14	3.0	9	5.7
Partial Reuse	45	9.8	18	11.4
Evaporation	34	7.4	9	5.7
Discharge to City Sewer	138	30.0	75	47.5
Discharge to Storm Sewer	13	2.8	5	3.2
Discharge to Receiving Stream	4	0.9	2	1.3
Impoundment of Plant Property	14	3.0	10	6.3
Incineration	2	0.4	1	0.6
Contract Hauling	123	26.7	61	97
Landfilled	18	3.9	10	6.3
Well or Septic Tank	1	0.2	-	0

*Some plants indicated multiple disposal methods.

Source: DCP

percent of all ink plants. Few plants employ any physical-chemical treatment or biological treatment. No ink plants use advanced wastewater treatment methods such as activated carbon or ultrafiltration. Of the plants that discharge their wastewater to a municipal sewer, less than one-third pretreat their waste prior to disposal. Only 84 plants indicated that the local municipality or sewage authority limited their discharges by an industrial waste ordinance, but 162 plants said that the municipality sampled their wastewater. Thirty plants were required to sample their own wastewater and 39 plants need a permit to discharge to the city sewer. Although many municipalities prohibit the discharge of solvents to the sewers, 26 ink plants indicated that they discharge their spent solvents to the sewer. Forty-three plants discharge spent caustic solutions to the sewer, either with or without neutralization. Two-thirds of the plants discharging to the sewer and responding to the appropriate question on the survey indicate that their discharge is batch, while the remaining plants discharge continuously.

Preliminary Treatment Systems

Approximately 10 percent of the ink plants responding to the DCP indicated the use of some type of preliminary treatment system (gravity separation, settling and/or neutralization). Sampling during the 1977/78 program was conducted at only one ink plant with wastewater treatment. Treatment at this plant consists of neutralization, oil skimming and settling. Data from two batches for this plant are presented in Table VII-3. These data indicate that removal for some pollutant parameters are excellent, while some organic toxic pollutants are not removed at all. However, additional data points are required before meaningful conclusions regarding this treatment system can be developed.

Physical-Chemical Treatment

Physical-chemical (P-C) treatment systems are basically enhancements of gravity settling systems. P-C treatment is commonly used in the paint manufacturing industry, which has many similarities to ink manufacturing. Most plants utilizing P-C systems operate them on a batch basis. The plant's wastewater flow collects in a holding tank until a sufficient quantity warrants treatment. If necessary, the pH is adjusted to an optimum level, a coagulant (often lime, alum, ferric chloride, or iron salts) and/or a coagulant aid (polymer) is added and mixed, and the batch is allowed to settle (from 1 to 48 hours). The supernatant is discharged, and the sludge is generally disposed of by contract hauling. Often the sludge is left in the treatment tank for one or more subsequent batches, to reduce the overall sludge volume. Solvents, oils, and skins may float to the surface where they are removed manually. A flow diagram of a typical batch P-C treatment system is presented in Figure VII-1.

TABLE VII-3

UNTREATED AND TREATED WASTEWATER CONCENTRATIONS AND PERCENT REMOVALS FROM INK PLANT 22

	Batch 1			Batch 2		
Parameter	Untreated(1)	Treated(2)	% Removal	Untreated(1)	Treated	% Removal
Conventional Pollutants:						
BOD	21000	2600	87			
Total Suspended Solids	1600	100	93	NR	1830	
Oil and Grease (mg/l)	2400	260	89	NR	5384	
Nonconventional Pollutants:						
COD (mg/l)	32000	4800	85	NR	6810	
TOC (mg/l)	4000	940	76			
Total Phenols	330	30	90	NR	400	
Total Solids (mg/l)	22600	5600	75	NR	15331	
Total Diss. Solids (mg/l)	21000	5500	73			
Total Volatile Solids (mg/l)	6300	200	96			
Volatile Diss. Solids (mg/l)	5300	153	97			
Total Vol. Sus. Solids (mg/l)	1000	47	95			
Aluminum	20000	600	97	31800	6710	78
Barium	20000	100	G 99	120000	4020	96
Iron	30000	L 2000	93	200000	4260	97
Manganese	400	L 50	87	1260	60	95
Calcium (mg/l)	71	L 50	29	39	L 5	87
Magnesium (mg/l)	13	9	30	8	1	87
Boron	L 500	L 500	0			
Cobalt	900	L 50	94	3110	670	78
Molybdenum	700	L 50	92	2760	2240	18
Tin	L 50	L 50	0	460	50	89
Titanium	3000	3000	0	5500	450	91
Vanadium	L 100	L 100	0	L 120	L 120	0
Yttrium	L 200	L 200	0	L 160	L 160	0
Sodium	3700	450	87	22	364	0
Inorganic Toxic Pollutants:						
114 Antimony	L 25	L 25	0	L 2000	L 2000	0
115 Arsenic	L 25	L 25	0	L 2000	L 2000	0
117 Beryllium	L 10	L 10	0	L 10	L 10	0
118 Cadmium	90	L 20	77	160	L 20	87
119 Chromium	10000	L 50	G 99	38100	4940	87
120 Copper	10000	L 60	G 99	62800	2170	96
121 Cyanide	330	30	90	NR	1300	
122 Lead	90000	L 200	G 99	150000	32500	78
123 Mercury	L 5	L 5	0	NR	L 1	
124 Nickel	L 50	L 50	0	2410	L 50	97
125 Selenium	L 25	L 25	0	L 2000	L 2000	0
126 Silver	L 10	L 10	0	L 10	L 10	0
127 Thallium	L 10	L 10	0	L 2000	L 2000	0
128 Zinc	1000	1000	0	2530	720	71
Organic Toxic Pollutants						
1 Acenaphthene				N-D	L 10	0
4 Benzene				220	96	56
7 Chlorobenzene				530	N-D	G 99
10 1,2-Dichloroethane	L 10	NR				
21 2,4,6 Trichlorophenol				L 10	N-D	G 99
23 Chloroform	L 10	NR				
28 3,3'-Dichlorobenzidine				N-D	L 10	0
31 2,4-Dichlorophenol				N-D	L 10	0
37 1,2 Diphenylhydrazine	7600	N-D	G 99			
38 Ethylbenzene				6700	2400	64
43 Di(2-Chloroethyoxyl) Methane				N-D	L 10	0
44 Methylene Chloride				45	29	35
51 Chlorodibromomethane				43	N-D	G 99
54 Isophorone	44000	N-D	G 99	N-D	46	0
55 Naphthalene	N-D	110	0	17	L 10	41
64 Pentachlorophenol				L 10	N-D	G 99
65 Phenol	L 10	18	0			
66 Di(2-ethylhexyl) Phthalate	L 10	19	0	L 10	L 10	0
67 Butyl Benzyl Phthalate				L 10	N-D	G 99
68 Di-N-butyl Phthalate	N-D	L 10	0			
69 Di-N-octyl Phthalate				N-D	L 10	0
72 1,2-Benzanthracene				N-D	L 10	0
76 Chrysene				L 10	N-D	G 99
78 Anthracene				N-D	L 10	0
80 Fluorene				L 10	N-D	G 99
81 Phenanthrene	N-D	12	0			
85 Tetrachloroethylene				22	N-D	G 99
86 Toluene	L 10	NR		3600	1100	69

Notes: (1) Discharge from caustic washer
(2) The plant's neutralization system malfunctioned during sampling.
L - Less than G - Greater than, NR - Not run, ND - Not detected.
Toxic Pollutant not measured in either stream are not indicated. All units ug/l unless otherwise noted.

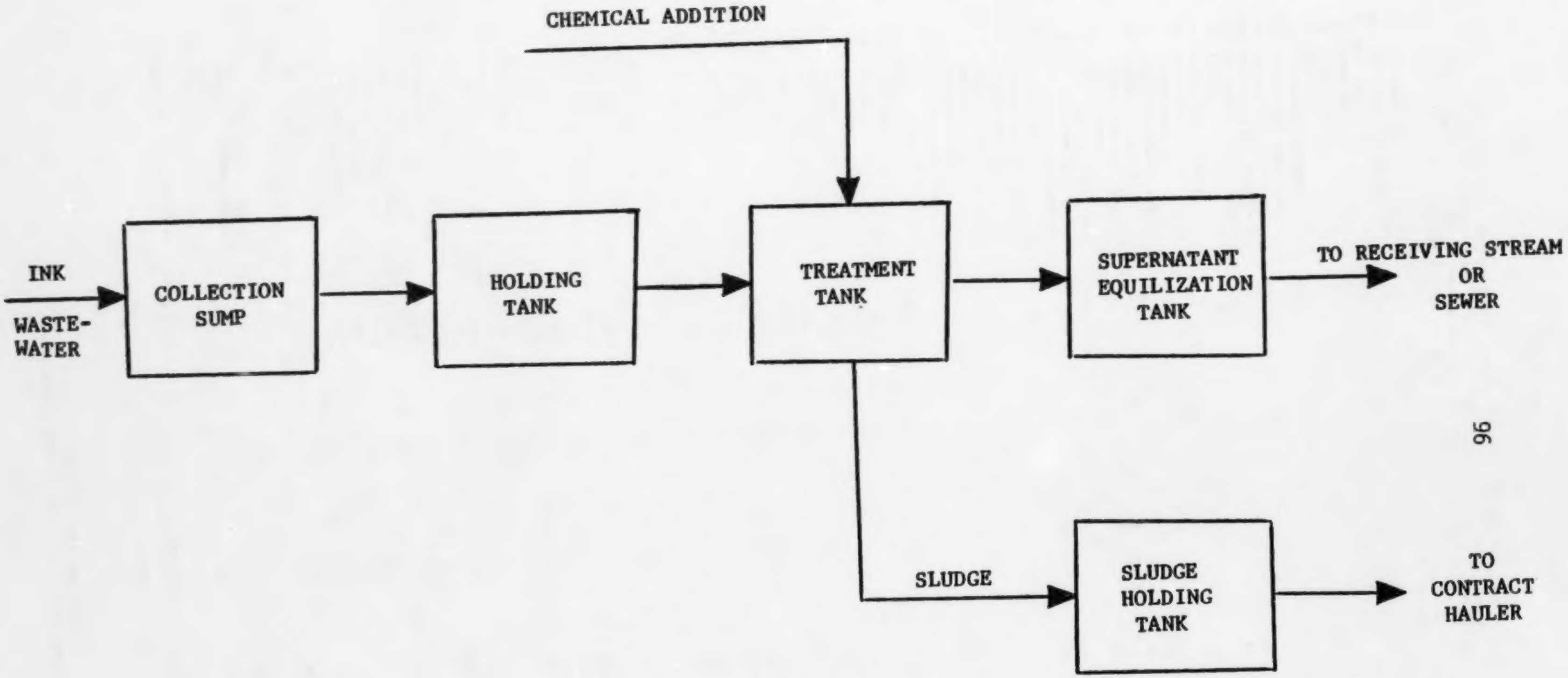
CHEMICAL ADDITION
INK
WASTE-
WATER
COLLECTION
SUMP
HOLDING
TANK
TREATMENT
TANK
SUPERNATANT
EQUILIZATION
TANK
TO RECEIVING STREAM
OR
SEWER
SLUDGE
SLUDGE
HOLDING
TANK
TO
CONTRACT
HAULER

FIGURE VII-1
FLOW DIAGRAM FOR A BATCH PHYSICAL-CHEMICAL TREATMENT SYSTEM
(mixers and pumps not shown)

Some plants operate continuous P-C treatment systems which operate on the same principal. Other plants operate semi-continuous P-C treatment systems, where the wastewater is collected, batch treated and released into a continuous flow settling tank. Most P-C systems in the paint and ink industries are batch, however, which seems best suited to their batch nature of wastewater generation.

P-C treatment systems for paint wastewater achieve good removal of some metals and some organic toxic pollutants, and excellent removal of suspended solids. P-C treatment may be applicable to ink wastewater to reduce metals, solids and some organics. As presented in Section VI, chromium, copper, lead, and zinc occurred frequently at relatively high concentrations in ink wastewater. P-C treatment in the paint industry achieved median removals of between 54 and 90 percent for these metals.

The cost of physical-chemical treatment for ink plants is presented in Section VIII. Several ink companies that have experimented with P-C treatment have reported that dewatering of sludge may be required to reduce sludge to 15 percent of the original wastewater volume and that filtration of the supernatant may be required to achieve good pollutant removals. Additional data on P-C treatment for ink wastewater will be required to accurately predict pollutant removals and design parameters.

Other Wastewater Treatment Systems

There are several wastewater treatment systems commonly used in other industries that may have potential for use by the ink industry. A description of what appear to be the most applicable are presented in the following paragraphs.

Biological treatment reduces some toxic pollutants in some industries. There are essentially no data on the applicability of biological treatment to ink wastewater, and very little data regarding its effectiveness on paint wastewater. In addition, biological treatment is probably not cost effective for the low flows (under 1,000 gpd) found in almost all ink plants.

Ultrafiltration (UF) is a membrane process that reduces the solids content of a feed stream by pressurizing the feed while it is in contact with a semi-permeable membrane. Water molecules pass through the membrane while solids are left behind. The automotive industry commonly uses UF for purification of electrolytic paint solutions by removing some water while "rejecting" valuable paint solids. Ultrafiltration also produces a concentrate stream consisting of rejected solids and some water, which requires disposal by contract hauling. No data are available on the effluent quality that can be expected from UF treatment of ink wastewater.

Activated carbon is a treatment process capable of removing some organic toxic pollutants by adsorption. It generally is applied after biological treatment has reduced a wastewater's strength to low BOD and TSS levels. Carbon is rapidly plugged by high solids loadings, and does not appear applicable to untreated ink wastewater or to effluent from batch physical-chemical treatment systems (based on typical removals from paint industry data applied to untreated ink wastewater). For carbon to treat ink wastewater effectively, extensive pretreatment would be required.

SECTION VIII

COST, ENERGY, AND OTHER NONWATER QUALITY ASPECTS

COSTS

Historical Cost Information

The DCP asked plants with installed wastewater treatment systems to report their capital and operating costs, and the year of installation. Most of the wastewater treatment systems used by the ink industry were installed since 1970. Of the plants that knew the date of installation of their system, five systems were installed before 1968, twelve between 1968 and 1972, and 21 from 1973 to mid-1977. The capital costs of wastewater treatment systems were provided from 33 plants. The range of costs was from $50 to $55,000 with a median value of under $1,000 (1977 dollars). Operating cost data was provided by 25 plants, and ranged from $10 to $9,000, with a median value of $1,000 in 1977.

Plants with wastewater treatment or caustic-washing systems often generate a sludge which is usually disposed of by contract hauling. Of plants that contract haul either their wastewater or sludges, 99 reported unit cost information for hauling and disposal. These costs are presented in Table VIII-1. The cost per unit volume is affected by such factors as transportion distance, disposal method used by the contractor, variation in landfill policy from state to state, etc. The reported median cost of contract hauling (transportation and disposal combined) was 2.9¢ per liter (11¢ per gallon), and the average cost was 4.2¢ per liter (16¢ per gallon). EPA expects these costs to rise as the states and federal government adopt more stringent solid and hazardous waste disposal requirements.

Cost Development

The following discussion presents the capital and operating costs for various wastewater treatment unit operations currently produced by the ink industry or used in other industries and having applicability to ink wastewater. All costs have a 1978 basis unless otherwise noted. The Agency has developed costs for three model plant sizes: 110 liters per day (30 gpd), 300 liters per day (80 gpd) and 950 liters per day (250 gpd). Because the size range for all ink plants is very narrow, and flows are relatively small compared to the entire wastewater treatment industry, little error will result from linear interpolation to determine intermediate costs between adjacent treatment plant sizes. Below 110 liters/day costs will increase only slightly as flow decreases, since most equipment is already at a minimum size.

TABLE VIII-1

COST OF SLUDGE OR WASTEWATER REMOVAL BY CONTRACT HAULER

Cost ($/gallon)	Cost ($/liter)	Number of Plants
1 - 5	Less than 1.3	20
6 - 10	1.6 - 3	27
11 - 15	3 - 4	16
16 - 20	4 - 5	8
21 - 30	5 - 8	19
31 - 40	8 - 11	5
41 - 50	11 - 13	3
Over 50	Over 13	1

Source: DCP

The Agency expects the costs presented to vary widely between plants, depending on geographical location, possible use of existing equipment, "off-the-shelf" components versus designed units, and other factors. An effort was made to cost the processes conservatively. Therefore, most plants should be able to purchase and operate the treatment systems covered at near or below the cost estimates presented.

EPA made the following assumptions throughout the cost evaluation section:

Plant Operations - Plants are assumed to operate 250 days annually, one shift per day. Treatment equipment is sized to treat all wastewater in one shift. Treatment of wastewater over two or three shifts can significantly reduce capital costs.

Depreciation - Annual depreciation is assumed at 17.7 percent of capital costs, which equals a capital recovery over ten years at 12 percent interest.

Contingency - A contingency of 15 percent is assumed.

Labor - Plant operator costs of $16,000 per man year, including labor taxes and fringe benefits, are assumed. Indirect labor was taken as 20 percent of operator costs, to account for occasional laboratory, management, and accounting involvement in wastewater treatment.

Power, Heat, and Light - Electricity costs are assumed to be $0.04 per kWh. The Agency calculated the annual power costs for mixing and pumping as follows:

(Total horsepower) x (Hours per year of operation) x (0.746) x $0.04.

Based on engineering visits, the Agency also assumed that most wastewater treatment or modification systems will be installed in existing buildings. No increase in heating and lighting costs is assumed, except as noted.

Piping and Valving - Required, piping is assumed to cost 50 percent of basic equipment costs.

Buildings, Yard, and Service Facilities - The Agency anticipates that most plants will construct required facilities in existing buildings. However, the installed cost of an outdoor steel utility building of appropriate size has been developed for plants without available space.

Land - Land costs were not included in cost calculations, but the total area required for each system is shown.

Electrical and Instrumentation - Required electrical installations are assumed to be 10 percent of total equipment costs.

Engineering, Freight, and Instrumentation - These costs are assumed to be 50 percent of total equipment costs. Package units from a single manufacturer, may significantly reduce these costs.

Operation and Maintenance - These are at 3 percent of capital costs per year.

Contract Hauling Costs - Most plants contract their wastewater or sludge hauling to outside firms, and pay a single cost for transportation and disposal. These costs range from less than 1.3¢ per liter (5¢/gal) to over 13¢ per liter (50¢/gal). The higher costs prevail in states which have restricted industrial sludges to designated landfills only. Therefore, an "average" or median cost has little meaning to plants that are forced to pay the higher fees. To be conservative, the Agency assumed contract hauling cost of 7¢ per liter (30¢/gal) including transportation to be characteristic of 1978 prices for the majority of all plants. As previously discussed, the cost of contract hauling may rise in the future because of more stringent state and federal regulations.

POTW Charges - POTW user charges are also highly variable, and often are computed as a percentage of the plant's water bill, according to wastewater strength and volume, or by some combination of these and other factors. A use charge of $5 per 3750 liters (1,000 gal) of wastewater was assumed, which allows for significant surcharges for high BOD and TSS loading.

Monitoring Costs - The cost of monitoring effluent to meet any new regulations is assumed to be $1,200 per year per plant regardless of size. This assumes that each plant will sample its wastewater once monthly, and pay a commercial laboratory to analyze chromium, copper, mercury, nickel, lead, zinc, BOD, and TSS. The exact monitoring cost will depend on the regulations adopted.

Physical-Chemical Precipitation

Physical-chemical (P-C) wastewater treatment was discussed in Section VII. The treatment design, is based on a batch system, and design information is presented in Table VIII-2. P-C capital costs are presented in Table VIII-3 and include four tanks, a collection sump, mixers, and pumps. The polymer feed system consists of two plastic tanks, two portable mixers, and two small feed pumps.

P-C operating costs are presented in Table VIII-4. For design and cost purposes, the Agency assumed that the flocculating and neutralizing agents used consist of alum, polymer, and sulfuric acid.

TABLE VIII-2

PHYSICAL-CHEMICAL TREATMENT SYSTEM DESIGN DATA

Wastewater Generated liters/day (gallons/day)	110 (30)	300 (80)	950 (250)
Square meters (ft^2) required	9 (100)	9 (100)	23 (250)
Height required, meters (feet)	3 (10)	3 (10)	3 (10)
Collection sump volume (liters)	1900	1900	1900
Polymer mix tanks volume (liters)	600	600	760
Holding tank volume (liters)	110	300	950
Treatment tank volume (liters)	110	300	950
Supernatant holding tank volume (l)	225	625	2000
Sludge holding tank volume (liters)	225	625	2000
Total continuous horsepower	1/2	1/2	3/4
Total intermittant horsepower (2hr/d)	2	2	3
Labor, direct required (manhours/d)	1	1	2
Energy required to operate system (kWh/yr)	4,000	4,000	6,000
Alum ($0.22/kg) dosage (kg/l)		.004 (all sizes)	
Polymer ($11/kg) dosage (mg/l)		10 (all sizes)	
Sulfuric Acid ($0.26/liter) dosage (l/l)		.002 (all sizes)	

TABLE VIII-3

PHYSICAL-CHEMICAL PRETREATMENT SYSTEMS CAPITAL COSTS

Wastewater Generated liters/day (gallons/day)	110 (30)	300 (80)	950 (250)
Collection Sump	$1,000	$1,000	$1,000
Tanks	1,600	3,000	6,000
Mixers	1,500	2,000	2,500
Pumps	1,200	1,500	2,000
Polymer Feed System	1,300	1,300	1,600
Piping and Valving	3,300	4,400	6,500
Subtotal	$9,900	$13,200	$19,600
Electrical and Instrumentation	1,000	1,300	2,000
Engineering and Installation	5,500	7,300	10,800
Contingency	2,500	3,300	4,900
Total	$18,900	$25,100	$37,300
Additional Utility Building, if required	$2,500	$3,000	$5,000

Historical data (see Section VII) indicate that sludge volume will average 15 percent of original wastewater volume. Sludge was assumed to be contract hauled.

Manual Physical-Chemical Treatment System

A simpler P-C system than that presented in Table VIII-3 is available to small plants that wish to avoid large capital expenditures. Such an alternative system can consist of plastic treatment tanks (or drums) and portable mixers and pumps. The system utilizes manual conveyance of wastewater to the treatment tanks (via pails) and manual addition of chemicals. The capital costs for such a system are presented in Table VIII-5, for 110 liter per day (30 gpd) and 300 liter per day (80 gpd) wastewater flows. Operating costs are indicated in Table VIII-6. Labor costs are assumed to be slightly higher than standard P-C systems and were given as two hours per day for both systems. The other design assumptions are the same as those in Table VIII-2.

Wastewater Disposal by Contract Hauling

This alternative holds the total wastewater flow for periodic removal by a contract hauler. The capital costs for this option are presented in Table VIII-7. Costs include a holding tank equal to 20 days flow for all model plants, with associated piping and installation.

Small plants may prefer to hold wastewater in drums to avoid capital expenditures. Plants with excess tankage can convert a spare tank to a wastewater holding tank at minimum expense.

Operating costs for contract hauling are indicated on Table VIII-8. All model plants are assumed to require one hour of labor daily to service the collection system. No costs for routine monitoring have been included because the wastewater will not be discharged to a waterway or sewer.

Wastewater Reduction System

As discussed in Section VII, one option for reducing wastewater volume is to replace standard tub rinsing operations with a high pressure low volume rinse system. The approximate capital costs for such a system are presented in Table VIII-9. The model system consists of 2 pumps to pressurize water to 1200-1500 psi, one-inch piping to selected points in the process area, and flexible hoses with connectors to reach individual tubs and other equipment. Operating costs are not presented, but are expected to compare to standard cleaning procedures.

TABLE VIII-4

PHYSICAL-CHEMICAL PRETREATMENT SYSTEMS OPERATING COST

Wastewater Generated liters/day (gallons/day)	110 (30)	300 (80)	950 (250)
Depreciation	$3,345	$4,445	$6,600
Labor - direct	2,000	2,000	4,000
Labor - indirect	400	400	800
Chemicals			
Polymers	3	8	25
Acid	15	40	125
Inorganic salt	25	60	190
Power	175	175	240
Maintenance	570	755	1,100
Sludge Disposal (including transportation)	340	900	2,810
POTW user charge	35	90	270
Monitoring	1,200	1,200	1,200
Total	$8,100	$10,100	$17,360

TABLE VIII-5

MANUALLY OPERATED PHYSICAL-CHEMICAL PRETREATMENT SYSTEMS CAPITAL COSTS

Wastewater Generated liters/day (gallons/day)	115 (30)	300 (80)
Tanks (plastic)	$ 95	$ 455
Mixers (portable)	700	700
Pumps	600	600
Piping, Valving	700	875
Material Handling Equipment	250	300
Subtotal	$2,345	$2,930
Electrical	235	295
Freight and Installation	1,290	1,615
Contingency	580	725
Total	$4,450	$5,565

TABLE VIII-6

MANUALLY OPERATED PHYSICAL-CHEMICAL PRETREATMENT SYSTEMS OPERATING COSTS

Wastewater Generated liters/day (gallons/day)	115 (30)	300 (80)
Depreciation	$ 790	$ 985
Labor - direct	4,000	4,000
Labor - indirect	800	800
Chemicals		
Polymers	3	8
Acid	15	40
Inorganic salt	25	60
Power	150	150
Maintenance	135	165
Sludge Disposal	340	900
POTW user charge	35	90
Monitoring	1,200	1,200
Total	$7,500	$8,400

TABLE VIII-7

WASTEWATER DISPOSAL BY CONTRACT HAULING CAPITAL COSTS

Wastewater Generated liters/day (gallons/day)	110 (30)	300 (80)	950 (250)
Holding Tank	$1,000	$2,100	$5,000
Piping and Valving	500	1,050	2,500
Subtotal	$1,500	$3,150	$7,500
Electrical and Instrumentation	150	315	750
Engineering, Freight and Installation	825	1,735	4,100
Contingency	375	780	1,900
Total	$2,900	$6,000	$14,250
Square Meters (feet) Required	5(50)	5(50)	12(125)
Additional Utility Building (if required)	$2,000	$2,000	$ 4,000

TABLE VIII-8

WASTEWATER DISPOSAL BY CONTRACT HAULING OPERATING COSTS

Wastewater Generated liters/day (gallons/day)	110 (30)	300 (80)	950 (250)
Depreciation	$ 515	$1,065	$2,500
Labor - direct	2,000	2,000	2,000
Labor - indirect	400	400	400
Maintenance	90	180	400
Sludge Transportation & Disposal	2,250	6,000	18,750
Total	$5,255	$9,645	$24,050

TABLE VIII-9

WASTEWATER REDUCTION THROUGH HIGH-PRESSURE TANK RINSING CAPITAL COSTS

Wastewater Generated liters/day (gallons/day)	110 (30)	300 (80)	950 (250)
Pump System (with motors, pressure regulators, and nozzles)	$ 7,000	$ 7,000	$ 7,000
Piping & Flexible Hoses	3,500	3,500	3,500
Subtotal	10,500	10,500	10,500
Electrical	1,050	1,050	1,050
Freight, Engineering and Installation	5,775	5,775	5,775
Contingency	2,600	2,600	2,600
Total	$19,925	$19,925	$19,925

NONWATER QUALITY ASPECTS

Energy

The energy use associated with physical-chemical treatment was presented in the preceding section for each model plant size. On an industry-wide basis, if all plants with a wastewater discharge installed P-C treatment systems, the total energy use would be approximately 0.5 to 1.5 MkWh/yr. This assumes that all plants currently discharging no wastewater will continue to do so. No additional credit was allowed for any systems which may already be in place. Contract hauling would not involve major additional energy expenditures by the ink industry.

Sludge Quantity and Characteristics

P-C treatment is not widely used by the ink industry, and EPA did not collect samples of ink sludges. If the entire industry were to install P-C treatment systems, the Agency estimates that 14,000 liters (3,600 gal) of sludge would be produced daily. This sludge would most likely have the same toxic pollutants as untreated ink wastewater, but at higher concentration. Untreated ink wastewater characteristics are listed in Table V-15.

If the entire wastewater volume of the ink industry is contract hauled, the toxic pollutant loading would equal that presented in Table V-18 (2.2 kg/d of organic toxic pollutants and 19 kg/d of inorganic toxic pollutants). Reduction of wastewater volume by high pressure rinse alone, without any other dry clean up procedures, will not affect the amount of pollutants discharged from the ink industry, but it can significantly reduce the wastewater volume and the disposal costs for plants that contract haul any of their wastewater.

Solvent-Wash Subcategory

Currently the only unregulated segment of the solvent-wash subcategory of the ink industry is the existing source indirect dischargers. A key point in favor of the no discharge regulations for the remaining segments of this subcategory was the proven cost effectiveness of on-site solvent recovery versus outside purchase of reclaimed solvent.

The July 1975 Development Document stated that the in-house cost of reclaiming solvents was 1.0 to 3.8¢/l (3.6 to 14.2¢/gal), while the selling price of reclaimed solvents was 10 to 30¢/l ($.40 to $1/gal). These costs compared favorably with the cost of purchasing new solvent.

The Agency updated these data with a telephone survey of ink plants using recovered solvent for tub cleaning.

Considering the rising costs of labor, energy, and sludge disposal, in 1979, solvents can be reclaimed for 5.4 to 8.5¢/l (20¢ to 30¢/gal), while reclaimed solvents are selling for 11¢/l (45¢/gal) to well over 30¢/l ($1/gal). New solvents generally cost over 30¢/l ($1/gal).

SECTION IX

EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE EFFLUENT LIMITATIONS GUIDELINES

INTRODUCTION

EPA determines the effluent limitations that must be achieved by July 1, 1984, by identifying the very best control and treatment technology employed by a specific point source within the industrial category or subcategory or by one industry where it is readily transferable to another. The Agency must specifically determine the availability of control measures and practices to eliminate the discharge of pollutants, taking into account the cost of such elimination.

Consideration also was given to:

- The age of the equipment and facilities;
- The processes employed;
- The engineering aspects of the application of various types of control techniques;
- Process changes; and
- Nonwater quality environmental impact (including energy requirements).

The Best Available Technology Economically Achievable (BAT) emphasizes in-process controls as well as control or additional treatment techniques employed at the end of the production process. It considers those plant processes and control technologies which, at the pilot plant, semi-works, and other levels, have demonstrated sufficient technological performances and economic viability to justify investing in such facilities. BAT represents the highest degree of demonstrated control technology for plant-scale operation up to and including "no discharge" of pollutants. The costs of this level of control are defined top-of-the-line current technology, subject to limitations imposed by economic and engineering feasibility. There may be some technical risk, however, with respect to performance and certainty of costs. Therefore, some process development and adaptation may be necessary for application at a specific plant site.

The statuatory assessment of BAT "considers" costs, but does not require a balancing of costs against effluent reduction benefits (see Weyerhaeuser v. Costle, supra). In developing the proposed BAT, however, EPA has given substantial weight to the reasonableness of costs. The Agency has considered the volume and nature of discharges, the volume and nature of discharges expected after application of BAT, the general environmental effects of the pollutants, and the costs and economic impacts of the required pollution control levels.

Despite this expanded consideration of costs, the primary determinant of BAT is effluent reduction capability. As a result of the Clean Water Act of 1977, the achievement of BAT has become the principal national means of controlling toxic water pollution. EPA has selected BAT technology which will significantly reduce this toxic pollution.

IDENTIFICATION OF BAT TECHNOLOGY

Both in-plant and end-of-pipe modification are necessary for most plants to achieve BAT. Control technologies are discussed in detail in Section VII while costs and operating parameters for model plants are given in Section VIII.

The Agency considered the following technologies:

In-Plant Controls

- wastewater reduction through high pressure water washing of equipment, dry floor clean-up and sealing of floor drains, and use of squeegees prior to tank cleaning.

- wastewater reuse through recycle of caustic rinses back into caustic tank as make-up and water rinses back into the product or rinse water.

End-of-Pipe Controls

- Physical-chemical treatment including coagulation/precipitation and sedimentation
- Biological treatment by aerated lagoons
- Contract hauling
- Evaporation
- Ultrafiltration
- Reverse Osmosis
- Activated carbon adsorption

Technology Options Available

Option One - Physical-chemical treatment (coagulation/precipation and sedimentation)

Option Two - Elimination of pollutant discharge through the use of contract hauling of nonrecyclable wastes.

Other evaluated technologies were unacceptable due to a lack of demonstrated effectiveness on ink wastewater or severe economic or nonwater quality impacts.

Rationale Used to Develop BAT Effluent Guidelines

Based on analysis of available control options, the Agency selected Option Two for the Caustic and/or Water-Wash Subcategory. The amount of wastewater generated by all ink plants is sufficiently small in volume to be contract hauled to hazardous waste disposal facilities. Strict control of water use through in-plant controls such as high pressure rinses and recycle of water and caustic washes, can reduce wastewater generation from ink plants significantly.

The remaining wastewater should be sufficiently small in volume to make contract hauling practical and eliminate any need for discharge. However, the basis of the analysis for BAT was contract hauling of 100% of wastewater currently generated. This was due to the fact that many plants produce water rinsed ink in batches as small as five pounds. Due to the relatively small volumes of water produced by ink plants, EPA assumed that most plants would choose to contract haul all wastes rather than attempt recycle or other in-plant controls.

The Agency rejected Option One because it fails to provide consistent removal of toxic pollutants to the level attained by Option Two. High concentrations of toxic pollutants have been measured in the effluents from plants using the best end-of-pipe technologies. Due to the toxic nature of ink manufacturing wastewater, the Agency has determined that disposal of these wastes to properly designed hazardous waste disposal sites is preferable to discharge to surface waters.

The most significant conventional pollutants and pollutant parameters controlled are BOD, TSS, oil and grease, and pH.

Size, Age, Production Methods, Raw Materials and Products, Tub Cleaning Techniques

Ink production uses process equipment which has not changed appreciably for many years. This equipment produces ink in batches of varying sizes. Therefore the age of a plant has little bearing on its waste characteristics. Size of a plant affects only the volume of wastewater produced. Raw materials used and products produced affect wastewater characteristics only to the extent that they affect equipment cleaning techniques. These techniques are the basis of subcategorization of the industry.

In summary, the factors of size, age, production methods, raw materials, and products are not significant to effective application of the control technology. Detailed discussion of the wastewater characteristics for the ink industry is available in Section V.

Engineering Aspects of Best Available Technology Economically Achievable

The effectiveness of in-plant controls has been described in detail in Section VII. Of the plants using a water rinse, 12 report that they generate no wastewater.

High pressure washing generally can reduce wastewater generation by 90%. Elimination of floor drains and subsequent dry clean up of spills, and use of squeegees or rags for precleaning of equipment can further reduce wastewater generation. The applicability of in-plant controls is dependent on the types and quantities of water rinsed ink produced. Plants which only occasionally produce water rinsed ink or make very small batches may not find in-plant controls to be cost-effective.

Simple volume reduction does not also reduce pollutant mass. It does concentrate pollutants in manageable volumes of water which then can be recycled back into product or contract hauled to hazardous waste disposal facilities. If wastewater can be recycled, valuable raw materials are reclaimed.

Nonwater Quality Environmental Impact

EPA anticipates, based on information transferred from its paint industry study, that the implementation of BAT at a plant will generate up to 0.2 liters of hazardous waste per liter of caustic or water-washed (water rinsed) ink produced. Ink plants currently, are classified as major sources of hazardous wastes, the principal components being off-specification batches, sludges from physical-chemical treatment, and untreated wastewater. BAT will increase the wastewater component of the generation of hazardous wastes and may reduce the sludge component as facilities adopt in-plant control alternatives to physical-chemical treatment. No significant change in consumptive water use or atmospheric quality in terms of air emissions, noise, or radiation will result from implementation of BAT.

Negligible amounts of energy will be used for pumping, mixing, and contract hauling of these wastes.

Total Cost of Application in Relation to Effluent Reduction Benefits

Based on the cost information in Section VIII the total investment and annualized costs are estimated to be negligible due to the nature of the current direct discharge by the ink industry. No ink plants discharge directly to surface water. BAT limitations are being issued to provide guidelines for current indirect dischargers who convert to direct discharge. No closures in the ink industry are expected as a result of the proposed limitations.

BAT EFFLUENT GUIDELINES

There shall be no discharge of pollutants in process wastewaters from the Caustic and/or Water-Wash Subcategory of the Ink Formulating Point Source Category. The prohibition of discharge of pollutants from the Solvent-Wash Subcategory promulgated in 40 CFR 447 on July 28, 1975, remains unchanged.

REGULATED POLLUTANTS

Issuance of this regulation will prevent discharges of all pollutants from affected ink plants. The significant toxic pollutants controlled are:

Chromium (Total)
Copper (Total)
Lead (Total)
Zinc (Total)
1,1,1-Trichloroethane
1,2-Diphenylhydrazine
Methylene Chloride
Isophorone
Ethylbenzene
Pentachlorophenol
Di(2-ethylhexyl) Phthalate
Toluene
Di-n-octyl Phthalate
Tetrachlorethylene
Trichloroethylene

SECTION X

NEW SOURCE PERFORMANCE STANDARDS

INTRODUCTION

The basis for New Source Performance Standards (NSPS) under Section 306 of the Act is the best available demonstrated technology. New plants have the opportunity to design the best and most efficient ink manufacturing processes and wastewater treatment technologies, and Congress therefore directed EPA to consider the best demonstrated processes and operating methods, in-plant control measures, end-of-pipe treatment technologies, and other alternatives that reduce pollution to the maximum extent feasible, including, where practicable, a standard permitting no discharge of pollutants.

IDENTIFICATION OF NEW SOURCE PERFORMANCE STANDARDS

New Source Performance Standards rest on the technology options considered for BAT in Section IX. Since BAT represents the current state-of-the-art technology, no further improvement for new sources is possible. Based on analyses of the technology options EPA selected BAT Option Two for NSPS for the Caustic and/or Water-Wash Subcategory. This option completely removes pollutants from ink plant discharges. Selection of BAT Option One would provide less stringent requirements for NSPS than BAT. This would be inconsistent with the basis for NSPS.

Rationale Used to Develop NSPS Effluent Limitations

The rationale used to select NSPS was identical to that used to select BAT in Section IX. No justification could be found for selecting a technology option for NSPS less stringent than BAT.

Size, Production Methods, Raw Materials and Products, Tub Cleaning Techniques

The aspects of size, production methods, raw materials, and products, and tub cleaning techniques for the ink industry discussed for BAT in Section IX also apply to NSPS.

Engineering Aspects of New Source Performance Standards

In addition to the engineering aspects discussed in Section IX for BAT, it should be noted that the design of new plants offers the opportunity to optimize performance of in-plant controls. This optimization should enable new plants to attain NSPS with reduced hazardous waste generation in comparison with many existing plants meeting BAT.

Nonwater Quality Environmental Impacts

The nonwater quality environmental impacts associated with NSPS effluent limitations are the same as those associated with BAT effluent limitations, as discussed in Section IX. The energy requirements to meet this standard should represent a small fraction of the plants' consumption.

Total Cost of Application in Relation to Effluent Reduction Benefits

At this time, 40 percent of all plants in the industry are indirect dischargers; the remaining 60 percent practice no discharge. The Agency expects that the majority of new firms entering the industry will be no dischargers or indirect dischargers. EPA does not expect any significant impacts.

NSPS EFFLUENT LIMITATIONS

There shall be no discharge of pollutants in process wastewaters from the Caustic and/or Water-Wash Subcategory of the Ink Formulating Point Source Category.

The prohibition of discharge of pollutants from the Solvent-Wash Subcategory promulgated in 40 CFR 446 on July 28, 1975, remains unchanged.

REGULATED POLLUTANTS

The pollutants controlled are identical to those controlled by BAT and discussed in Section IX.

SECTION XI

PRETREATMENT STANDARDS FOR EXISTING SOURCES

INTRODUCTION

The effluent limitations that must be achieved by existing sources in the ink industry that discharge into a publicly owned treatment works (POTW) are termed pretreatment standards. Section 307(b) of the Act requires EPA to promulgate pretreatment standards for existing sources (PSES) to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTW. The Clean Water Act of 1977 adds a new dimension by requiring pretreatment for pollutants, such as heavy metals, that limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. The legislative history of the 1977 Act indicates that pretreatment standards are to be technology-based, analagous to the best available technology for removal of toxic pollutants. The general pretreatment regulations (40 CFR Part 403), which served as the framework for these proposed pretreatment regulations for the ink industry, can be found at 43 FR 27736-27773 (June 26, 1978).

Consideration was also given to the following in establishing the pretreatment standards:

- o Plant size, age of equipment and facilities, production methods, raw materials and products, tank cleaning techniques;
- o The engineering aspects of the application of pretreatment technology and its relationship to POTW;
- o Nonwater quality environmental impact (including energy requirements); and
- o The total cost of application of technology in relation to the effluent reduction and other benefits to be achieved from such application.

Pretreatment standards must reflect effluent reduction achievable by the application of the best available pretreatment technology. This may include primary treatment technology as used in the industry and in-plant control measures when such are considered to be normal practice within the industry.

A final consideration is the determination of economic and engineering reliability in the application of the pretreatment technology. This must be determined from the results of demonstration projects, pilot plant experiments, and most preferably, general use within the industry.

IDENTIFICATION OF PRETREATMENT STANDARDS

Ink plants discharge almost exclusively to POTW. Less than 15% of the plants use some pretreatment technologies and 13% practice in-plant controls to reduce wastewater generation. The technologies considered for pretreatment are identical to those considered for BAT in Section IX with the exception of solvent reclamation which was considered for solvent-wash inks. Analysis of the technologies resulted in the development of two options for pretreatment standards for existing sources.

Technology Options Available:

Option One - Physical-chemical treatment by coagulation/flocculation and sedimentation (BAT Option One)

Option Two - No discharge of pollutants through the use of contract hauling of nonrecyclable wastes (BAT Option Two)

Other evaluated technologies were unacceptable due to a lack of demonstrated effectiveness on ink wastewater, or severe economic or nonwater quality impacts.

Rationale Used to Develop Pretreatment Standards for Existing Sources

The elimination of pollutant discharge for solvent-wash ink is based on the hazardous and toxic nature of these wastes and the economic advantage in reclaiming the solvents. Since no water is used in cleaning solvent-wash equipment, the solvents and off-specification batches comprise the entire discharge of this subcategory. Most plants in the subcategory currently meet no discharge. The Agency is requiring that the remainder of the industry meet this level of good practice.

As in BAT, caustic or water-wash subcategory pretreatment standards are based on contract hauling of all wastewater generated. It is possible to reduce waste generation through the use of in-plant controls such as high pressure rinses, recycle of water and caustic washes. The Agency rejected Option One because they fail to provide consistent removal of toxic pollutants to the level attained by Option Two. Due to the toxic nature of ink wastewater, EPA has determined that the disposal of these wastes to properly designed hazardous waste disposal sites is preferable to discharge to POTW.

Size, Age, Production Methods, Raw Materials and Products, Tub Cleaning Techniques

As previously noted in Section IX for BAT, ink is produced with methods and equipment which are relatively uniform from plant to plant. As a result, the factors of size, age, production methods, raw materials and products do not affect wastewater characteristics significantly. Tub cleaning techniques are the fundamental factors which control these characteristics. Therefore, the subcategorization of the ink industry is based on use of solvent, caustic or water for tub cleaning.

Engineering Aspects of Pretreatment for Existing Sources

Waste solvents produced by tub and equipment cleaning can be regenerated easily through distillation. Not surprisingly, many plants recover their solvents and distill them on site. Other plants sell waste solvents to scavengers who regenerate and market them. Few plants therefore have any reason to discharge waste solvents to the POTW.

As noted in Section IX for BAT, the use of in-plant controls significantly reduces wastewater from caustic and/or water-washed ink formulation which must be eliminated.

Recycle, high pressure rinses, dry clean up of floors, and precleaning of tubs with squeegees or rags are all techniques to reduce wastewater for disposal to 0.2 liter/liter or less. The removal of the non-recyclable wastes by contract hauler to a hazardous waste disposal site should provide an acceptably safe method of disposal for these toxic materials. Recycle of wastewater to the product conserves raw materials in addition to saving water.

Nonwater Quality Environmental Impacts

EPA estimates that the implementation of PSES will generate an additional 23,000 metric tons (wet) of hazardous wastes. It should be noted that PSES also will commensurately reduce concentrations and quantities of toxic pollutants in POTW sludges. These sludges will become more amenable to a wider range of disposal alternatives, possibly including beneficial use on agricultural lands. Moreover, disposal of adulterated POTW sludges is significantly more difficult and costly than disposal of smaller quantities of wastes from individual plant sites.

No significant change in consumptive water use or atmospheric quality in terms of air emissions, noise, or radiation will result from implementation of PSES.

Total Cost of Application in Relation to Effluent Reduction Benefits

Based on the cost information presented in Section VIII, elimination of pollutant discharges by ink plants to POTW is possible with a total capital investment of 1.5 million dollars. The annualized cost for the industry will be 3.0 million dollars.

PRETREATMENT STANDARDS FOR EXISTING SOURCES

There shall be no discharge of pollutants in process wastewaters from the Solvent-Wash Subcategory and the Caustic or Water-Wash Subcategory of the Ink Formulating Point Source Category.

REGULATED POLLUTANTS

Issuance of this regulation will prevent the discharges of all pollutants from affected indirect dischargers. The most significant toxic pollutants controlled are:

Chromium (Total)
Copper (Total)
Lead (Total)
Zinc (Total)
1,1,1-Trichloroethane
1,2-Diphenylhydrazine
Methylene Chloride
Isophorone
Ethylbenzene
Pentachlorophenol
Di(2-ethylhexyl) Phthalate
Toluene
Di-n-octyl Phthalate
Tetrachlorethylene
Trichlorcethylene

If the Agency had selected Pretreatment Option One for the caustic and/or water-wash subcategory, numerical mass limitations would be used. Concentration values are not appropriate due to the ease with which dilution can occur by indiscriminate water use in equipment cleaning.

The mass limitations are based on the median percent removal observed in the paint industry, average observed pollutant concentration in untreated wastewater reported in Table V-15, and wastewater discharge of 0.2 liter per liter of water rinsed ink produced. Since no operating precipitation systems were found in the ink industry, it was necessary to transfer the performance of this treatment option from the paint industry. Both industries have similar wastewaters.

The resulting daily maximum mass limitations would be:

Pollutant	mg/1000 liters water rinsed ink	lb/1000 gallons water rinsed ink
Chromium (Total)	3240	0.02710
Copper (Total)	1060	0.00890
Lead (Total)	3021	0.02520
Zinc (Total)	82	0.00070
1,1,1-Trichloroethane	16	0.00020
Ethylbenzene	166	0.00140
Di(2-ethylhexyl) Phthalate	75	0.00060
Tetrachloroethylene	5	0.00004
Toluene	84	0.00070
Trichloroethylene	67	0.00060

SECTION XII

PRETREATMENT STANDARDS FOR NEW SOURCES

INTRODUCTION

Section 307(c) of the Act requires the EPA to promulgate Pretreatment Standards for New Sources (PSNS) at the same time that it promulgates NSPS. New indirect dischargers, like new direct dischargers, have the opportunity to incorporate the best available demonstrated technologies including process changes, in-plant controls, and end-of-pipe treatment technologies, and to use plant site selection to insure adequate treatment system installation.

IDENTIFICATION OF NEW SOURCE PRETREATMENT STANDARDS

New Source Pretreatment Standards were based on the options considered for PSES in Section XI. Since PSES represents the current state-of-the-art technology, no further improvement for new sources is possible.

Based on analyses of the technology options, EPA chose PSES Option Two for PSNS for the caustic and/or water-wash subcategory. This option completely eliminates pollutant discharges from ink plants to POTW. Selection of PSES Option One would provide less stringent requirements for PSNS than PSES and would be inconsistent with the basis for PSNS limitations.

Rationale Used to Develop PSNS Effluent Limitations

The rationale used to select PSNS was in fact identical to that used to select PSES in Section XI. No justification could be found for selecting a technology option for PSNS less stringent than PSES.

Size, Production Methods, Raw Materials and Products, Tub Cleaning Techniques

The aspects of size, production methods, raw materials and products, and tub cleaning techniques for the ink industry discussed for PSES in Section XI also apply to PSNS.

Engineering Aspects of New Source Performance Standards

In addition to the engineering aspects discussed in Section XI for PSES, it should be noted that the design of new plants offers the opportunity to optimize performance of in-plant controls. This optimization should enable new plants to attain PSNS with reduced hazardous waste generation in comparison to many existing plants meeting BAT.

Nonwater Quality Environmental Impacts

The nonwater quality environmental impacts associated with NSPS effluent limitations are the same as those associated with PSES, as discussed in Section IX. Energy consumption in order to attain new source performance should represent a negligible fraction of total plant consumption.

Total Cost of Application in Relation to Effluent Reduction Benefits

Based on the cost information in Section VIII, EPA estimates that the complete elimination of pollutants in new source process wastewater indirect discharges may add 0.6 cents per pound to the price of ink.

PRETREATMENT STANDARDS FOR NEW SOURCES

There shall be no discharge of pollutants in process wastewaters from the Caustic and/or Water-Wash Subcategory of the Ink Formulating Point Source Category.

The prohibition of discharge of pollutants from the Solvent-Wash Subcategory promulgated in 40 CFR 446 on July 28, 1975 remains unchanged.

REGULATED POLLUTANTS

The pollutants controlled are identical to those controlled by PSES and discussed in Section XI. If the Agency had selected pretreatment Option One for the Caustic and/or Water-Wash Subcategory, numerical mass limitations equal to those calculated for this option in Section XI would have been used.

SECTION XIII

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SECTION XIV

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SECTION XV

GLOSSARY

Additive

One of a number of materials added to ink in small amounts to alter one or more of its properties. They include driers, antiskinning agents, dispersing agents, waxes, lubricants, surface active agents, etc.

Background Level

The amounts of toxic pollutants present in process intake waters (tap water).

BATEA

Limitations for point sources which are based on the application of the Best Available Technology Economically Achievable. These limitations must be achieved by July 1, 1984.

Ball Mill

A horizontally mounted cylindrical tank containing steel or ceramic balls that reduce particle size of materials when the tank is rotated.

Batch

Any manufacturing or treatment process which accumulates a fixed volume of material (i.e., wastewater) for processing, treatment or discharge. Compare to Continuous.

Binder

The components in an ink film which hold the pigment to the printed surface.

Biochemical Oxygen Demand (BOD5)

The amount of oxygen required by microorganisms while stabilizing decomposable organic matter under aerobic conditions. The level of BOD5 is usually measured as the demand for oxygen over a standard five-day period. Generally expressed as mg/l.

BOD

Biochemical Oxygen Demand

Capital Costs

Expenditures which result in the acquisition of, or the addition to, capital or fixed assets. Costs associated with the installation of such assets are included in capital costs.

Captive Manufacturing Site

A plant which only manufactures ink for internal use or use by other divisions of a parent organization.

Carbon Black

An intensely black, finely divided pigment obtained by burning natural gas or oil with a restricted air supply.

Caustic Rinse

The cleaning of residue from ink tubs with a caustic solution. See Closed Loop Caustic System, Open Caustic System and Partial Recycle Caustic System.

Caustic Soda

In its hydrated form it is called sodium hydroxide.

Chemical Oxygen Demand (COD)

A measure of the amount of organic matter which can be oxidized to carbon dioxide and water by a strong oxidizing agent under acidic conditions. Generally expressed as mg/l.

Chemical Treatment

A process involving the addition of chemicals to wastewater to induce the settling of solid matter and remove dissolved materials. Materials commonly used in chemical treatment include polyelectrolytes, lime and alum. (See also Physical-Chemical Treatment.)

Clarification

Any process or combination of processes, the primary purpose of which is to reduce the concentration of suspended matter in a liquid.

Closed Loop Caustic System

A tank cleaning system which recycles a primary caustic rinse and uses all of a secondary water rinse as make-up water for the caustic. (Compare to Open Caustic System and Partial Recycle Caustic System.)

COD

Chemical Oxygen Demand

Continuous

Any manufacturing process which produces a continuous flow of product or wastewater and treats or discharges wastewater at the same rate at which it is generated. (Compare to Batch.)

Contract Hauling

The collection of wastewater or sludge by a private disposal service, scavenger, or purveyor in tank trucks or by other means for transportation from the site.

Cost Center

A business whose objective it is to accomplish its mission within cost or expense parameters. A cost center realizes no income.

Discharge of Wastewater

The release of treated or untreated wastewater to a receiving water, POTW, or any other location that is off-site. Examples of instances where wastewater is generated but not discharged are total recycling, total on-site containment, contract hauling of wastewater, and total evaporation.

Disperser

Mixing machine that acts to disperse the components of ink.

Dispersing Agent

A reagent that is compatible with the solvent and holds finely divided matter dispersed in the solvent.

Drier

A composition which accelerates the drying of printing ink or varnish. Driers are available in both solid and liquid forms.

Drying Oil

An oil which readily takes oxygen from the air and changes to a relatively hard, tough film by oxidation and polymerization.

Epoxy Resins

Plastic or resinous materials used for strong, fast-setting adhesives, as heat resistant coatings and binders, etc.

Equalization

Any process for averaging variations in flow and/or composition of wastewater so as to effect a more uniform discharge.

Evaporation of Wastewater

A disposal method in which natural or induced heat causes evaporation of wastewater.

Extender

See Filler.

Filler

Inert substance in a composition to increase the bulk, strength, and/or lower the cost, etc.

Flexographic Ink

Quick drying, low viscosity ink based on volatile solvents that are used in the flexographic printing process. Flexographic inks can be water-based.

Flotation

Dissolved Air Flotation (DAF) or dispersed air flotation, which are processes that inject air into wastewater causing dissolved and suspended material to float to the surface for removal.

Flushing

A method of transferring pigments from dispersions in water to dispersions in oil by displacement of the water by oil. The resulting dispersions are known as flushed colors.

Generation of Wastewater

The process whereby wastewater results from the manufacturing process. Wastewater may be generated but not discharged. (See Discharge of Wastewater.)

Gravity Separation

Any process in which oil, grease, skins, or other floating solids are allowed to rise to the surface, where they are skimmed off, while heavier solids are allowed to settle out.

Gravure Ink

Quick drying, low viscosity inks based on volatile solvents.

Heat Set Inks

Letterpress and lithographic inks which dry under the action of heat by evaporation of their high boiling solvent.

Ink

See Printing Ink.

Inks, Quick-Setting

These inks for letterpress and offset dry by either filtration, coagulation, selective absorption or often a combination of these with some of the other drying methods. The vehicles are generally special resin-oil combinations which, after the ink has been printed, separate into a solid material which remains on the surface as a dry film and an oily material which penetrates rapidly into the stock. This rapid separation gives the effect of very quick setting or drying.

Inorganic Pigments

A class of pigments used in printing ink manufacture consisting of compounds of the various metals. Example: Chrome Yellow.

Lagoon

A shallow body of water, such as a pond or lake, which can be used for impoundment for purposes of storage, treatment, or disposal.

Landfill

A solid waste land disposal technique in which waste is placed in an excavation and covered with earth. Wastewaters and sludges may occasionally be disposed of in landfills.

Letterpress Ink

Ink used for typographic (raised type) printing which is a viscous, tacky ink which cures by oxidation.

Lithographic Inks

Inks used in the lithographic process. The principal characteristic of a good lithographic ink is its ability to resist excessive emulsification by a reservoir of dampering solution.

Metallic Inks

Inks composed of aluminum or bronze powders in varnish to produce gold or silver color effects.

Moisture-set Inks

Inks that dry or set principally by precipitation. The vehicle consists of a water insoluble resin dissolved in a hygroscopic solvent. Drying occurs when the hygroscopic solvent has absorbed sufficient moisture either from the atmosphere, substrate or external application to precipitate the binder. An important characteristic of these inks is their low odor.

Mineral Spirits

A petroleum derivative used as a vehicle for inks and varnishes. It usually boils in the range of 149 to 204°C (300 to 400°F) and has a flash point just about 27°C (100°F).

Mixing

The incorporation of ingredients into a coating with the use of little or no shearing energy.

NPDES (National Pollutant Discharge Elimination System) Permit

A permit issued by EPA or an approved state program to point sources which discharge to public waters allowing the discharge of wastewater under certain stated conditions.

Neutralization

Addition of acid or alkali until the pH is approximately neutral (i.e., pH = 7).

News Inks

Printing inks designed to run on newsprint, consisting basically of carbon black or colored pigments dispersed in mineral oil vehicles, which dry by absorption. Recent developments utilize emulsion, oxidation, and heat set systems.

Noncontact Cooling Water

Water which is used for cooling purposes but which has no direct contact with and is in no way contaminated by either the manufacturing process or contaminated wastewaters. In the cooling process, however, it may experience a change in temperature.

OSHA

The Occupational Safety and Health Act.

Organic Pigments

General classification of pigments which are manufactured from coal tar and its derivatives. Compared with inorganic pigments as a class, they are generally stronger and brighter. Example: Lithol Rubine.

Organosol

A suspension of particles in an organic solvent, most usually made with vinyl resins, solvents and plasticizers.

Opaque Ink

An ink that does not allow the light to pass through it and has good hiding power. It does not permit the paper or previous printing to show through.

Open Caustic System

Any tank or tub cleaning system that does not reuse any part of a secondary water rinse following caustic-washing.

Operating Costs

Expenses necessary for the maintenance and operation of capital assets, including depreciation, interest, labor, materials, etc.

pH

The reciprocal logarithm of the hydrogen ion concentration in wastewater expressed as a standard unit.

POTW (Publicly Owned Treatment Works)

Wastewater collection and treatment facilities owned and operated by a public authority such as a municipality or county.

Partial Recycle Caustic System

A tank or tub cleaning operation which recycles a primary caustic rinse and uses only a portion of secondary water rinse as make-up water for the caustic. (Compare to Closed Loop Caustic System and Open Caustic System.)

Physical-Chemical

The method of treating wastewaters using combinations of the processes of coagulation, flocculation, sedimentation, carbon adsorption, electrodialysis or reverse osmosis. As used in this study, a physical-chemical treatment system involves the addition of chemicals to wastewater to induce the settling of solids and removal of dissolved materials, followed by mixing and sedimentation.

Pigment

The colorant used to give printing inks the desired hue and color.

Plasticizer

A substance added to printing ink to impart flexibility.

Printing Ink

Any fluid or viscous composition of materials, used in printing, impressing, stamping, or transferring on paper or paper-like substances, wood, fabrics, plastics, films or metals, by the recognized mechanical reproductive processes employed in printing, publishing and related services.

Process Wastewater

Any used water which results from or has had contact with the manufacturing process, including any water for which there is a reasonable possibility of contamination from the ink manufacturing process or from raw material-intermediate product-final product storage, transportation, handling processing or cleaning. Examples of process wastewater include wastewater generated by tub washing or floor cleaning, etc. Cooling water, sanitary wastewater, storm water and boiler blowdown are not considered process wastewater if they have no contact with the process.

Profit Center

A business or portion of a business whose objective it is to contribute income over and above its expenditures and allocated charges.

Public Waters

All navigable waters of the United States and the tributaries thereof; all interstate waters and tributaries thereof; and all intrastate lakes, rivers, streams and tributaries thereof not privately owned.

Purveyor

See Contract Hauling.

Reclaimed

Water or solvent which has been treated and restored for use.

Recycle of Wastewater

The piping of wastewater, whether treated or not, from its points of final collection to a prior process step.

Resin

A natural or synthetic material that is an ingredient of ink and which binds the various other ingredients together. It also aids adhesion to the surface.

Reuse of Wastewater

The collection of either treated or untreated wastewater for the purpose of utilization in a prior step of the manufacturing process.

Scavenger

See Contract Hauling

Screening

Samples taken of untreated wastewater only to determine the absence or presence of toxic pollutants (see also Verification).

Settlement Agreement

An agreement between the National Resources Defense Council (NRDC) and EPA remanding 21 industrial categories, one of which is paint and ink manufacturing and printing, for review of BATEA, including a study of toxic pollutant levels.

Settling

The process of disposition of suspended matter carried by a liquid by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material.

Shellac

An alcohol-soluble natural resin widely used in flexographic inks.

Silk Screen Ink

Quick drying, full bodied, volatile inks used in the silk screen printing process.

Skimming

The removal of floating matter that has risen and remains on the surface of wastewater.

Sludge Conditioning

Treatment of liquid sludge by chemical addition, dewatering, filtration, drying, or other methods.

Spray Irrigation

Transport of sludge or wastewater to a distribution system from which it is sprayed over an area of land. The liquid percolates into the soil and/or evaporates. None of the sludge or wastewater runs off the irrigated area.

Solvent-Base Ink

Inks which use oil or solvent as the primary vehicle.

Thermosetting Ink

A thermosetting ink is one which polymerizes to a permanently solid and infusible state upon the application of heat.

Thinners

Solvents, diluents, low viscosity oils, and vehicles added to inks to reduce their consistency or tack.

Tint

A very light color produced by adding a small amount of color to an extender.

Total Organic Carbon (TOC)

A measure of the amount of carbon in a sample originating from organic matter only. The test is run by burning the sample and measuring the carbon dioxide produced.

TOC

Total Organic Carbon

Total Suspended Solids (TSS)

Solids that either float on the surface of, or are in suspension in, water and which are largely removable by filtering or sedimentation.

Toxic Pollutant

One of the elements or compounds on a list of 129 derived from the Settlement Agreement (See Appendix E of this document).

Treatment

Any process of conditioning water, wastewater, or sludge prior to use, reuse, or discharge.

Varnish

A transparent liquid that dries on exposure to air to give a decorative and protective coating when applied as a thin film. Varnish may be made by reacting an oil and a resin at high temperature and dissolving in a suitable element (Cooked Varnish), or by blending a previously made resin with a solvent (Cold Blended Varnish).

Verification

A sampling program including samples of untreated and treated wastewater and sludge to determine the levels of classical pollutant and toxic pollutants known to be present, as well as removal efficiencies by various wastewater treatment processes. (See also Screening.)

Volatile Fraction

That portion of a ink which evaporates from the film during the drying process.

Water-Base Ink

Inks containing a vehicle whose binder is water soluble or water dispersible.

APPENDIX A

DATA COLLECTION PORTFOLIO

INK FORMULATING INDUSTRY SURVEY

A. General Information (Note: For Multiple Plant Companies, Complete one questionnaire for each manufacturing site.)

1. Name of Firm______________________________

2. Plant Location and Mailing Address____________________
(including zip code)
____

3. Telephone Number____________________________

4. Name and Title of Respondent____________________________________

5. Address and Telephone Number of Respondent (if different)____________________
____

6. Indicate your type of business organization: (Multiplant Companies indicate status of parent company.)

Incorporated, Publicly Held ☐ Incorporated, Privately Held ☐ Partnership ☐

Proprietorship ☐ Cooperative ☐

7. Indicate the status of this site:

a. The Company's only manufacturing location ☐ b. A branch of a multiple plant company ☐

c. A division (or subsidiary) of a parent or affiliated company ☐ d. A captive manufacturing site ☐

e. Other____

8. If b, c, or d is checked for Question 7, this Facility is a: Cost Center ☐ Profit Center ☐ (See definitions)

B. General Plant Operations (Ink Manufacturing Only)

1. Indicate number of employees at this site:

	Less Than 10	10-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-150	More Than 150
Average (1976)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Maximum (1976)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Age of Ink Manufacturing operation (years):

Less than 3 ☐ 3-5 ☐ 6-10 ☐ 11-20 ☐ 21-30 ☐ More than 30 ☐

3. Total 1976 annual product volume (pounds):

Less than 200,000 ☐ 200,000-500,000 ☐ 500,000-1 million ☐ 1 million-3 million ☐

Greater than 3 million ☐

Exact production (if know)____

4. Indicate the percent of maximum production capacity your plant achieved in 1976:

0-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61-70 ☐ 71-80 ☐ 81-90 ☐ 91-100 ☐

5. Average annual production over the last 5 years (pounds):

Less than 200,000 ☐ 200,000-500,000 ☐ 500,000-1 million ☐ 1 million-3 million ☐ Greater than 3 million ☐

Exact Production (if known)____

6. Approximate annual value of production at this plant ($):

Less than 250,000 ☐ 250,000-500,000 ☐ 500,000-750,000 ☐ 750,000-1,000,000 ☐ 1,000,000-1,250,000 ☐

1,250,000-1.5 million ☐ 1.5 million-3 million ☐ Over 3 million ☐

7. Number of production shifts per day: 1 ☐ 2 ☐ 3 ☐

8. Length of shifts (hours): 7 ☐ 8 ☐ 10 ☐ 12 ☐ Other________

9. Number of days of production per week:

Less than 4 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐

10. Indicate the number of the various size fixed and portable ink manufacturing tubs (tanks) at your plant that require cleaning (use closest tub size shown). Do not include any dedicated storage tanks (i.e. solvent, resin, etc.) or ball mills that are rarely or never cleaned.

	Number of Tubs					
Tubs Size (Gallons)	0	1-5	5-10	10-20	20-50	More than 50
Less than 5	☐	☐	☐	☐	☐	☐
6-10	☐	☐	☐	☐	☐	☐
10-50	☐	☐	☐	☐	☐	☐
51-100	☐	☐	☐	☐	☐	☐
101-250	☐	☐	☐	☐	☐	☐
251-500	☐	☐	☐	☐	☐	☐
501-1000	☐	☐	☐	☐	☐	☐
over 1000	☐	☐	☐	☐	☐	☐

11. Indicate the number of days per year the ink plant operates:

150-200 ☐ 201-250 ☐ 251-300 ☐ 301-365 ☐

Exact (if known) ____________________________

12. Indicate the average daily water consumption for all uses (see question 13) within the ink manufacturing facility (gallons per day)

0-10,000 ☐ 10,000-20,000 ☐ 20,000-30,000 ☐ 30,000-50,000 ☐ 50,000-100,000 ☐ Over 100,000 ☐

Actual (if known) __________gpd

13. Indicate the percent of water used for each of the following:

	Percent of Total Water Usage											
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-99	100
Used in Product	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cooling Water	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Boiler Feed	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tub & Equipment Cleaning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sanitary	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Air Pollution Control	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other______________	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

C. Production Breakdown

Indicate the appropriate percent of production for the four categories listed below:

	Percent of Total Pounds of Inks Produced											
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100
General Production												
1. General Sales	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Captive Production	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Product Type												
3. Paste	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Liquid	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Vehicles Used in Product												
5. Water Base or Water Washable	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Oil Base	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Solvent Base	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pigments Used in Product												
8. Organic	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Inorganic	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Do you manufacture varnish at this site? Yes ☐ No ☐

D. Tub (tank) and Equipment Cleaning Operations and Housekeeping

1. Indicate the method(s) used to clean tanks, tubs, filling machines, etc. (check as many as applicable):

Water Rinse ☐ Caustic Wash ☐ Solvent Wash ☐ Dry Clean Up Techniques ☐ Periodic Caustic Soak ☐

2. If you use a caustic system, indicate which type:

Closed Loop (Complete Recycle) ☐ Open (No Recycle) ☐ Partial Recycle ☐

3. If you use a water rinse, indicate the water pressure used:

Less than 50 psi ☐ 51-100 psi ☐ 101-150 psi ☐ Greater than 150 psi ☐

4. Indicate the appropriate frequency for each of the following equipment cleaning or housekeeping operations:

	All The Time	Most of The Time	Occasionally	Never
Clean tubs between each batch	☐	☐	☐	☐
Reuse spent rinse water in subsequent batches	☐	☐	☐	☐
Reuse spent rinse water to wash tubs, equipment, etc.	☐	☐	☐	☐

5. Do you pick up spills using dry clean-up methods? Yes ☐ No ☐

6. Are any floor drains connected to the storm sewer? Yes ☐ No ☐

7. Are any floor drains connected to the sanitary sewer? Yes ☐ No ☐

8. Indicate approximately how much water is used to clean the tub sizes listed:

Tub Size (Gallons)	Volume of Water Used to Clean a Tank (Gallons)				
	0-5	6-10	11-50	51-100	More than 100
Less than 10	☐	☐	☐	☐	☐
10-50	☐	☐	☐	☐	☐
51-100	☐	☐	☐	☐	☐
101-250	☐	☐	☐	☐	☐
251-500	☐	☐	☐	☐	☐
501-1000	☐	☐	☐	☐	☐
More than 1000	☐	☐	☐	☐	☐

9. If you use solvent washing, is your spent solvent redistilled? Yes ☐ No ☐

10. Do you redistill solvent at this site? Yes ☐ No ☐

If yes, do you use steam injection distillation Yes ☐ No ☐

If steam injection distillation is used, what is the disposition of the contact steam condensate

Discharged to storm sewer ☐ Discharged to sanitary sewer ☐ Mixed with cooling water ☐

Mixed with other process wastewater ☐ Other ☐

11. If caustic is used for tub or equipment cleaning, is spent caustic discharged to the sanitary sewer? Yes ☐ No ☐

12. If solvent is used for tub or equipment cleaning, are spent solvents discharged to the sanitary sewer?

Yes ☐ No ☐

E. Other Wastewater Sources

1. Do you use wet scrubbers in the ink plant for air pollution control?

Yes ☐ No ☐

2. Which of the following other air pollution control devices do you utilize? (Ink manufacturing operations only)

Afterburners ☐ Electrostatic Precipitators ☐ Baghouse Collectors ☐ Cyclones ☐ Filters ☐

Other____

3. Indicate which of the following wastewaters are combined with tub cleaning wastewater before disposal:

Wet Scrubber ☐ Boiler Blowdown ☐ Boiler Cleaning ☐ Non-Contact Cooling ☐ Sanitary ☐ Laboratory ☐

Steam Condensate ☐ Other (indicate)______________________________

F. Wastewater Handling and Disposal

1. Total volume of ink process wastewater generated daily (gallons):

	0	1-100	101-250	251-500	501-750	751-1000	Over 1000
Average	☐	☐	☐	☐	☐	☐	☐
Peak	☐	☐	☐	☐	☐	☐	☐

2. Indicate the method(s) of disposal of wastewater:

Complete Reuse or Recycle ☐ Evaporation ☐ Partial Reuse or Recycle ☐ Discharge of City Sewer ☐

Discharge to Storm Sewer ☐ Discharge to Receiving Water ☐ Impoundment and Storage ☐ Incineration ☐

Ocean Dumping ☐ Scavenger, Outside Contractor or Purveyor ☐ Landfill or Land Disposal ☐

Deep Well Injection ☐

3. Total volume of ink process wastewater discharged from plant daily (gallons): (See definitions)

	0	1-100	101-250	251-500	501-750	751-1000	Over 1000
Average	☐	☐	☐	☐	☐	☐	☐
Peak	☐	☐	☐	☐	☐	☐	☐

4. If process wastewater is discharged to public waters, do you have an NPDES permit? Yes ☐ No ☐

5. Have you made an application for an NPDES permit for process wastewater? Yes ☐ No ☐

6. Have you applied for and/or received an NPDES permit for cooling waster or stormwater runoff? Yes ☐ No ☐

7. If yes to 4, 5 or 6 indicate the name of stream or water body receiving your wastewater______________________________

____

8. If process wastewater is discharged to city sewer, indicate the name and address of the sewer authority or municipality:______________________________

____

____

9. Indicate if the municipality or sewage authority utilizes any of the following:

Industrial Waste Ordinance ☐

Sewer Use Charges or Surcharges ☐

Wastewater sampling at your plant ☐

Local permit system to discharge to the sewer ☐

Requires you to sample and analyze your own wastewater ☐

10. Is your ink process wastewater treated or conditioned in any way before disposal? Yes ☐ No ☐

11. If process wastewater is treated by the plant prior to discharge, indicate which wastewater streams are combined with the process wastes prior to treatment, and the extent of their contribution to the wastewater stream:

Wastewater Source	Percent of Total Wastewater Stream Undergoing Treatment						
	0%	1-20	21-40	41-60	61-80	81-99	100
Ink Process Wastewater	☐	☐	☐	☐	☐	☐	☐
Resin Manufacturing Wastewater	☐	☐	☐	☐	☐	☐	☐
Boiler Blowdown	☐	☐	☐	☐	☐	☐	☐
Air Pollution Control	☐	☐	☐	☐	☐	☐	☐
Sanitary	☐	☐	☐	☐	☐	☐	☐
Cooling Water	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐

12. Indicate method(s) of wastewater treatment or conditioning used at your site:

Neutralization ☐
Settling or Clarification ☐
Flotation ☐
Chemical Treatment (polymer) ☐
Lagoon ☐
Carbon Adsorption ☐

Equalization ☐
Evaporation ☐
Chemical Treatment (lime) ☐
Trickling Filter ☐
Gravity Separation ☐

Filtration ☐
Chemical Treatment (alum) ☐
Activated Sludge ☐
Chemical Treatment (other)
____
____

13. Is your wastewater treatment system batch ☐ or continuous ☐

14. Is your wastewater discharge batch ☐ or continuous ☐

15. Provide the following information for your in-plant wastewater treatment facility:

Year Installed 19__

Installed capital cost ($)______________________

Approximate annual operating costs ($)______________________

Design Volume (gpd)______________________

16. If you are required to pay a sewer bill, sewer use charge or surcharge for the ink formulating plant's wastewater discharge, indicate the annual amount:

$______________________

17. If wastewater is treated at your site, what is the disposition of sludge produced:

Stored on plant property ☐
Contract disposal ☐
Trucked to appropriate landfill by plant ☐

Incinerated ☐
Reclaimed ☐

Sold ☐

Other____

18. Is sludge conditioned in any way before disposal? Yes ☐ No ☐

19. If wastewater, spent solvent or sludge is hauled away by outside contractors, indicate their name(s), address, and phone number:____
____
____
____
____

20. Indicate how the outside contractors or scavenger disposes of the wastewater or sludge:

City Landfill or Dump ☐
Reclaim or Reuse ☐

Private Landfill or Dump ☐
Don't know ☐

Incineration ☐
Other (indicate)______________

21. What is the approximate cost per gallon of contract disposal: Cents Per Gallon______________¢

22. If you have in-plant wastewater treatment, what percent of the wastewater flow ends up as sludge

0-5% ☐ 6-10% ☐ 11-15% ☐ 16-20% ☐ 21-25% ☐ Over 25% ☐

23. Indicate how you handle off-spec or other spoiled batches:

Discharge with Wastewater ☐
Blend into or utilize in another product ☐

Sell to Scavengers ☐

Give to Scavengers ☐

Other (indicate)____

24. Indicate which of the following analyses have been done on your wastewater or sludge

pH ☐
BOD ☐
COD ☐

Suspended Solids ☐
Total Solids ☐
Heavy Metals ☐

Oil and Grease ☐
Turbidity ☐
Trace Organics ☐

Other (indicate)____

25. If you responded positively for any of the analyses listed above, please attach data sheets summarizing the analytical information you have collected for the last four years. Indicate whether the analyses are for untreated or treated wastewater, and whether the process wastewater stream was combined with other waste streams at the point of sampling.

26. Estimate the combined new investment and total operating costs that will be required during the next four years to meet existing water pollution control regulations on the local, state and Federal levels.

Total New Investment required $____________________

Annual Operating Costs $____________________

27. Indicate which of the following miscellaneous regulatory areas you expect will require significant investment over the next four years:

Odor ☐ Thermal ☐ Solid Waste ☐ OSHA ☐

Air Pollution Control ☐ Toxic Substances Act ☐ Safe Drinking Water ☐

28. Estimate the anticipated new investment and annual operating costs to meet the current requirements of these other regulatory considerations over the next four years:

Total New Investment Required $____________________

Annual Operating Costs $____________________

G. RAW MATERIALS

Please check the appropriate box for each class of raw material which is used at this site (regardless of quantity used). If you are not positive about the heading used, check the list of tradenames and numbers and check the box if you use one of the materials listed. If you use an unlisted material which is described exactly by the heading, check the box; listing the other material is optional. If there is no "other" listed for any category, check the box only if one of the specific listed materials is used. Abbreviations used for company names are listed at the end of this section.

PIGMENTS, DYES, FLUSHES AND DISPERSIONS^{a}

☐ WHITE LEAD

Cyastab^{R} Series
Hammond: "Halcarb" Series
Eagle Picher: "E-P-202", "E-P-303", "E-P-41"
Oncor^{R} 45X
Other:

☐ ANTIMONY OXIDE

Chemtron: WT 6200 Series
Harshaw: KR, KR-TS
NL Ind.: Regular (TMS); Red Star; Grade 10; FM-1;
Oncor^{R}-23A; 75RA; 75RAX
Other:

☐ ZINC SULFIDE PIGMENTS

Farm-O-Lith^{R}
Other:

☐ ZINC OXIDE-AMERICAN

ASARCO: "AZO"-11,22,33,55,55LO,55TT
ASARCO: "AZODOX" Series
Eagle-Picher: "E-P-AAA Series
N.J. Zinc - "XX" Series
Oxide^{R} 30-P
St. Joe Minerals: "St.Joe"" - 17, 20,40
Other American Zinc Oxides:

☐ ZINC OXIDE FRENCH

ASARCO - AZO 66, 77, 77S
N.J. Zinc: Florence Green Seal - 8; "KADOX" 25,515
St. Joe Minerals: "St. Joe" - 911
Other:

☐ ZINC YELLOW

F.B. Davis: 505W, 505WJ, J1345, 533W, 533WJ, J1310
Dupont: Y-539-D
Other:

☐ ZINC DUST AND FLAKES

N.J. Zinc: "Standard Zinc Dust" - 22,44,422, 444, 64;
"High Purify Zinc Dust" - 122,222
U.S. Bronze: 751, 752
Other:

☐ OTHER METALLIC POWDERS AND FLAKES CONTAINING NICKEL, SILVER, COPPER, LEAD AND/OR BRONZE

Alcan: "MD" Series
U.S. Bronze: "Cupro-Nickel"
Other:

☐ CADMIUM RED

Ferro Corp.: V-8860, V-8560, V-8840, V-8830, V-8530
V-8820, V-8521, V-8835, V-8825, V-8845
V-8540
General Color: 800, 805, 813, 824, 827, 1000, 101
1020, 1024, 1027, 2000, 2012, 202
2024, 2027, 3015, 3020, 3022, 3027
1005
Glidden: "Cadmolith" 200 Series; 2000 Series
Harshaw: "Lithopone Red" Series; CP 1400 Series;
CP 1500 Series
Hercules: X-2327, X-3327, X-2328, X-3328, X-2329
X-3329, X-2330, X-2947, X-2948, X-2949
X-2950X
Other Cadmium Reds:

☐ CADMIUM-MERCURY RED, MAROON, ORANGE

Cadmarc^{R} Series
Harshaw: 18060, 18120, 18210, 18290, 18370, 18410
CP Cadmium Series
Mercadium^{R} Red Series
Other:

☐ CHROME GREEN

Am. Cyanamid: "Norwood Green" 10-4000 Series
Hercules: A-4400 C.P. Series
Other:

☐ HYDRATED CHROMIUM OXIDE

Hercules: X-1010, X-1483, X-2944
Pfizer: GN-8869
Other:

☐ CHROMIUM OXIDE

F.B. Davis: 3020, J 5310, J 5351
Hercules: X-1134 C.P., X-1861 C.P.
Pfizer: G 4099, G 5099, G 6099, G 6139, G 7099
Other

PIGMENTS, DYES, FLUSHES AND DISPERSIONS (Cont.)

☐ CADMIUM YELLOW AND ORANGE

Ferro: V-9820, V-9520, V-9810, V-9510, V-8810, V-8815
General Color: 920, 950, 970, 620, 640, 660
Cadmolith^R Series
Glidden: 3050, 3150, 3250, 3350, 3450, 3550
Harshaw Chem.: 1400 Series; 1500 Series; Primrose - 20, 206,
23, 1400 Series.; Lemon 30, 306, 32, 33,
Yellow 40, 406, 42, 43, 45, 456, Light
Orange 50
Hercules: X-2272, X-2273, X-2283, X-2315, X-2821, X-2825,
X-2823, X-2824, X-2825, X-2826, X-3201, X-3203,
X-3205, X-2320, X-2328, X-2945, X-2946
Other Cadmium Yellow and Orange:

☐ CHROME YELLOW

Am. Cyanamid - Yellow 40 Series, Primrose 40 1450, 1460
F.B. Davis - J1200 Series
Dupont - Y-758-0; Y-433-0; 434 D, 469 D, Krolor^R KY Series
Harshaw: "Yellow 2000" Series; "Grellow" 3950, 3951,
"Primrose" Series, Softex Series
Hercules: X-1937, X-3148, X-1945, X-2558, X-1899, X-2548,
X-3355, X-1809, X-2541, X-3356, X-2891, X-2774,
X-3215, X-2777, X-2778, X-3218, X-3480, X-1810
X-2035, X-3431, X-3459 Rampart^R HR Med.
Oncor^R Y47-A
Nichem: 1561E, 1590, 1610E, 1610, 3105E, 3105, 6777E,
1678PD, 1677PD, 1605PD, 1640, 1670
Reichhold: Yellow 45-100 Series, 45-200 Series
Other Chrome Yellows:

☐ CHROME ORANGE

Harshaw: 2201, 2204, 2213, 2205, 2209, 2203
Hercules: X-819 CP Light
Other:

☐ MOLYBDATE ORANGE CONTAINING CHROMIUM AND/OR LEAD

Am. Cyanamid: Orange 400-8000 Series
Dupont: Moly. Orange YE Series; Krolor^R Or.Y. KO-789-0;
Krolor^R Or.Y. KO-786-0; Krolor^R Red, Kr-980-0
Harshaw: "King Orange" Series
Hercules: Rax^{TM} Orange Series, "Chili Red" X-3170,
Rampart^R Or - X-3386, X-3390; Rampart^R HR Or X-3047
Nichem: Moly. Or. 1720, 1730, 1740
Reichhold: Orange 45-365, 45-366, 45-370, 45-382
Other Molybdate Oranges:

☐ RED LEAD, LITHARGE, BLUE LEAD, ETC.

Eagle-Picher: Eagle 97 Red Lead; Eagle 29 Litharge;
Eagle 33 Litharge; Eagle Sublimed Blue
Lead
Hammond: "Litharge" 100Y; Red Lead - 85%, 95%, 97%
98%, Orange Mineral
NL Ind: Red Lead 95%, 97%, 98%; "Fume" Litharge;
"Color Makers" Litharge
Other:

☐ PHLOXINE RED

☐ LUMINESCENT PIGMENTS CONTAINING LEAD

Hostasol^R 13-3397, 3398, 3399, 11-5100
Other:

☐ ULTRAMARINE BLUE CONTAINING SILVER

Davis Co.: 410B, 448, 449, 458B, 4156M, 4532B
Kohnstamm: A4575, A9829
Landers-Segal: 5301F, 5303F, 5183F, 5400F
Wittaker, Clark, Daniels: 500 Series
Other:

☐ IRON BLUE CONTAINING CYANIDES

Am. Cyanamid: 50-0000 Series, "Alkaloric", "Milori",
"Blackstone"
F.B. Davis: "Milori" Blue 4049, 4215
Harshaw: "Milori" Blue AR 4028, 4050
Hercules: X-640 C.P., X-2274 C.P., X-3163 C.P.,
X-2285-C.P., X-1835-C.P., X-712 C.P.
A-984 C.P., X-3434, X-3340
Other:

☐ BROWN AND GRAY PIGMENTS CONTAINING ZINC AND/OR CHROMIUM

Ferro: V-9117, V-9119, V-9121, V-5101, V-5102,
F-6109, F-6111, F-6112, F-6113, V-9128
Harshaw: 7733, 7739, 7751, 7760, 7776,
Hercules: 10393, 10352, 10369, 10392, 10327, 10391,
10378, 10328, 10363, 10394
Other Browns and Grays Containing Zinc And/Or Chromium

☐ PHTHALOCYANINE BLUE

Am. Cyanamid: "Cyan" 55-3000 Series
Hostaperm^R 15-1000 Series
BASF: "Paliofast" Blue - 6000 Series, 7000 Series
Chemtron: BT-4510, BL-4521, BT-4559, BT-4561,
BT-4564, BT-4614, BT-4651
Irgazin^R Blue 3GT
Irgalite^R Blue LGLD
Dupont: Monstral^R Blue BT Series, BL Series,
"Ramapo" Blue - BP Series
Harmon Colors: B-4714, B-4769, B-4773, B-4804
Harshaw: "Zulu" Blue 4800 Series
Hercules: X-2925, X-3374, X-3048, X-2303, X-3414,
X-3228, X-2371, X-2810, X-3367, X-3453,
X-2658, X-2372, X-3241, A-4434, X-3485,
X-3527, X-9120, X-9220, Monarch^{TM} Blue. Series
Hilton-Davis: 30-0286, 30-0291, 30-0344;
SUP-R-CONC^R 6-68-C-301
Kohnstamm: A5712 "Monafast" Blue
Nichem: "Phthalo" Blue 5000 Series, 1140;
Sandoz: "Graphthal" Blue BNK
Sun Chem: Sunfast^R Blue and Peach Blue Series
Other Phthalocyanine Blue:

☐ PHTHALOCYANINE GREEN

Am. Cyanamid: Cyan Green Y15-3040; B15-3100
Hostaperm^R 16-2000 Series
BASF: Paliofast Green 8600, 8680, 8720, 9140, 9360
Chemtron: GT 4800 Series
Dupont: Monstral^R Green GT Series
"Ramapo" Green B, GT-501-D
Harmon Colors: G-5000 Series
Harshaw: "Zulu" Green - 3800 Series
Hercules: X-3166, X-3167, A-4433, A-4436
Hilton-Davis: 30-0315, 30-325; SUP-R-CONC^R
6-68-C-401 B.S.
Kohnstamm: B 1581, A 5776
Nichem: Phthalo Green 4000 Series
Sandoz: "Sandorin" Green 3GLS
Sun Chem: Sunfast^R Green 264-0000 Series; Sunfast^R 464
Series; "Emerald Vista" Green 264-444
Other Phthalocyanine Greens:

☐ CORROSION INHIBITING PIGMENTS CONTAINING CHROMIUM

F.B. Davis: Strontium Chromate J-1365
Calcium Chromate J-1376
Hercules: X-2865, X-2974 Strontium Chromate
Other:

☐ CORROSION INHIBITING PIGMENTS CONTAINING ZINC

FB. Davis: Zinc Molybdate 0830, Zinc Phosphate 0852
"NALOX" ZK-111
NL Ind.: Nalzin^R SC-1, "Moly-White" 101, 212
Other:

☐ CORROSION INHIBITING PIGMENTS CONTAINING LEAD

Eagle Picher: "Permox" 1-4-3, "Permox" SC
Hammond: P-7, C-9
NL Ind.: "Dyphos", Oncor^R F-31, Oncor^R M-50
Other:

☐ DIARYLIDE ORANGE TONER (DICHLOROBENZIDENE-DERIVED)

Am. Cyanamid: "Diarylide Or. "45-2850, 45-2880 Series
Am. Hoechst: "Perm. Or." 12-1000 Series
Chemtron: OT-5661
Harmon: OP-5833
Hercules: X-2065, X-3082
Sandoz: 3272-0
Sun Chem: 276-2384
Other Diarylide Orange Toners (Dichlorobenzidane Derived):

PIGMENTS, DYES, FLUSHES AND DISPERSIONS (Cont.)

☐ DIARYLIDE YELLOW TONER (DICHLOROBENZIDENE-DERIVED)

Am. Cyanamid: 45-2555, 45-2650
Am. Hoechst: 11-1101, 1103, 1006, 1003, 1200, 1300, 1216,
1300, 1216, 1012, 1013, 1305, 1125
1012, 1013, 1305, 1125
Chemtron: YT-8073, YT-8047, YT-8093
Irgalite^R Yellow LBAW
Harmon Colors: YB-5700 Series
Harshaw: Yellow 1200 Series
Hercules: X-2485, X-1940, X-2476, X-2600, X-2882, X-3385,
X-2838, X-2864, X-3446, X-3535, X-9340
Hilton-Davis: Diarylide Yel 30-0535; Sup-R-Conc^R Series
Kohnstamm: A9145, A9744, B3503, B3577, B3615
Nichem: "Benzidine Yel" 3000 Series
Sandoz: 4233-0, 4335-0, 4534-0; "Graphtol Yellow" RCL
Sun Chem: "Rangoon Yel" 273-0000 Series; "Radiant Yel"
274-0000 Series; "Lemon Metallic" - 275-0003,
275-5129; "Diarylide Yel" 275-0049; "TransPerm
YHR" 275-2233
Other Diarylide Yellow Toners (Dichlorobenzidene Derived):

☐ PYRAZOLONE REDS AND MAROONS (DICHLOROBENZIDENe DERIVED)

Am. Hoechst: 13-1000 "Perm Red" VB
Harmon Colors: R-6200 Series
Harshaw: "Pyrazolone Red" 1153
Sun Chem: "Anisco Red" 236-5025
Other:

☐ MISCELLANEOUS REDS, MAROONS TONERS AND LAKES CONTAINING ZINC, CHROMIUM, AND/OR LEAD

Am. Hoechst: 13-4305 "Perm Pink" R-0
Chemtron: RT-5310; RT-5340; RT-5390
Other:

☐ MISCELLANEOUS YELLOW AND ORANGE TONERS AND LAKES CONTAINING ANTIMONY AND/OR CHROMIUM

BASF: "Paliotol Yellow" -1690, 1770, 2330;
Harshaw: "Meteor Buff" 7370, 7376
"Meteor Orange" 7383
"Meteor Tan" 7729

Other:

☐ MISCELLANEOUS YELLOW AND ORANGE TONERS AND LAKES CONTAINING COPPER AND/OR DICHLOROBENZIDENE (DERIVED)

BASF: "Paliotol Yellow" 1070
Harshaw: "Pyrazalone Orange" 2912
Other:

☐ MISCELLANEOUS YELLOW AND ORANGE TONERS AND LAKES CONTAINING NICKEL

BASF: "Paliotol Yellow" 0830
DuPont: "Green Gold" YT-714-D, YT-562-D
Harshaw: "Sun-Yellow-S", N8310, C8320, "Sun-Buff"
8380
Hercules: X-3247 "Empress Green Yellow", 10401
Other:

☐ MISCELLANEOUS BLUE, PURPLE AND VIOLET PIGMENTS CONTAINING CHROMIUM

Ferro: V-5200 Blue; V-5272 Blue-Green, V-5274
Med. Blue
Harshaw: "Meteor Cobalt" - BLR-7536
"Meteor Cobalt" - BL 7550, 7556
"Meteor Turquoise-Cobalt" 7579

Other:

☐ MISCELLANEOUS BLUE, PURPLE AND VIOLET PIGMENTS CONTAINING CADMIUM

Hercules: 10312 "Cerulean Blue"
Other:

☐ MISCELLANEOUS BLACK PIGMENTS CONTAINING COPPER

Ferro: V-302, V-717, F-2302, F-6331,
Harshaw: 7890 "Meteor Bk"
Other:

☐ MISCELLANEOUS BLACK PIGMENTS CONTAINING CHROMIUM

Ferro: V-6730
Hercules: 10335 Black
Other:

☐ MISCELLANEOUS YELLOW PIGMENTS CONTAINING ANTIMONY, LEAD, AND/OR ZINC

Hercules: 10315 Lemon Yellow, 10324 Amber,
10401 Yellow

Other:

☐ AQUEOUS DISPERSIONS - WHITE CONTAINING ANTIMONY

Aurasperse^R Antimony Oxide W-320 XR LTS
Other:

☐ AQUEOUS DISPERSIONS - RED (DICHLOROBENZIDENE DERIVED)

Podell: W-5031 "Pyrazolone Red"
Other:

☐ AQUEOUS DISPERSIONS - YELLOW (DICHLOROBENZIDENE DERIVED)

Colanyl^R Yellow OT 11-1109
Aurasperse^R W-1041
Hercules: X-2413, X-2453, X-3611
Sandoz: "Graphtol Yellow" 4534-2
Podell: W-3827
Other:

☐ MISCELLANEOUS GREEN PIGMENTS CONTAINING COPPER OR CHROMIUM

Ferro: F 5686, 5687, 7687, 7610, 11633, 11649,
11655, 11656
Harshaw: Sun Green L 8420, Meteor 7416, 7459
Hercules: 10342, 10329, 10307, 10402
Other:

☐ AQUEOUS DISPERSIONS - YELLOW CONTAINING LEAD AND/OR CHROMIUM

Hydrotint^R D 512, D536
Aurasperse^R W-1031
Harshaw B-1133
Inmont: 991 B022 Chrome Lemon Yellow, 991 038
Chrome Medium Yellow
Podell: W3013, W3507, IW3499, W3903, W3904
Aquasperse^R 877-000-2065
Colortrend^R GP8865 G
Other Aqueous Dispersions - Yellow Containing Lead
and/or Chromium:

☐ AQUEOUS DISPERSIONS - YELLOW CONTAINING NICKEL AND/OR CADMIUM

Aurasperse^R W1061, W1068
Hercules: X-3291
Podell: W3941, W3946
Other:

☐ AQUEOUS DISPERSIONS - ORANGE CONTAINING LEAD

Daniel: UL 20-49 Molybdate Or.
Hydrotint^R D-5022
Aurasperse^R W-2013
Inmont: 991-8-018 Moly Orange
Podell: W-4017, IW4596
Aquasperse^R 877-000-0941
Other:

☐ AQUEOUS DISPERSIONS - ORANGE (DICHLOROBENZIDENE DERIVED)

Aurasperse^R W-2090
Imperse^R X-2457, X-3346
Kodis^R N-54, AD-54
Podell: W-4124
Sandoz: "Graphtol" OR, 3272-2, 3333-2
Other:

PIGMENTS, DYES, FLUSHES AND DISPERSIONS (Cont.)

☐ AQUEOUS DISPERSIONS - GREEN CONTAINING COPPER AND/OR CYANIDES

Colanyl^R Green 16-2005, 16-2001, 16-2010
Chemetron: WDG-55,
Daniel: WD2744, UL20-77, UCS 10-70D, AC 66-78, UL 20-79
Hydrotint^R D-3658
Aurasperse^R W-6011
"Aquis" Monastral^R Green - B,GW-749-P
Harshaw: "Thalo" Green MC-0
Imperse^R Green - X-2346, X-2454, X-2689, X-3244, X-3288,
Hilton-Davis: 6-11-8-462; 6-11-8-432; 6-33-T-410
Inmont: 991-8-041 "Phthalo" Green B/S; 991-006 "Green Phthalo" Y/A
Landers-Segal: 3336D "Phthalo" Green W.D.
Podell: W-2603A, IW-2829
Sandoz: Graphtal Green 5869-2
Aquasperse^R 877-000-5511
Cal-Tint^R UC-3022, 3046, 3011
Colortrend^R GP-8811D
Tenneco: "Thalo" Green 897-000-5501
Other Aqueous Dispersions - Green containing Copp and/or Cyanides:

☐ AQUEOUS DISPERSIONS - GREEN CONTAINING CHROMIUM

Daniel: UCS 10-72K
Hydrotint^R D-310
Aurasperse^R W 6017
Harshaw: Chromium Oxide MC-K
IMPerse^R Green X2722, X3289
Podell: W-2035, W2607A, W2817
AquaSperse^R 877-000-4205
Cal-Tint^R UC-3005
Colortrend^R GP-8805K
Other Aqueous Dispersions - Green Containing Chromium:

☐ AQUEOUS DISPERSIONS - BLUE CONTAINING COPPER AND/OR CYANIDES

Colanyl^R Blue 15-1006
Chemetron WDB56
Microsol^R Brilliant Blue 4G Paste
Daniel: AC 66-27, WD 2228, UL 20-26, UCS 10-20E
Hydrotint^R D4546
"Aquis" Monastral^R BW-372-P, BW-431-P
Aurasperse^R W4123
Harshaw: "Phthalo" Blue MC-E, B-4011
IMPerse^R Blue X-2345, X-2446, X-2687, X-2688, X-2663, X-3221 X-3496
Hilton-Davis: 6-11-B-325 "Phthalo" Blue; 6-33-T-315 "Phthalo" Blue (G.S.)
Inmont: 991 037, 9918-040;
Kodis^R Blue N-21
Podell: W-6402, W-6307R, IW-62934, IW-6942
Sandoz: "Graphtol" Blue 6812-2, 6825-2
Tenneco: 895-000-7202 "Thalo" Blue
Aqua-Sperse^R "Thalo" Blue - 877-000-7026, 877-000-7214
Cal-Tint^R Blue UC-3014; Colortrend^R Blue - GP 8814E
Other Aqueous Dispersions -Blue Containing Copper And/or Cyanides:

☐ AQUEOUS DISPERSIONS - BLUE CONTAINING SILVER

Hydrotint^R D4051
Kodis^R Blue AD-23
Landers-Segal: 5494-0 Ultramarine Blue, WD
Podell: W-6032, IW-6940
Aquasperse^R 817-000-7504 Ultra Blue
Cal-Tint^R Blue - UC-3074
Other:

☐ NON-AQUEOUS DISPERSIONS - BLUE CONTAINING SILVER

Alkytint^R 5448
Daniel: AL 221
Inmont: 6297
Tenneco: 7504
Other:

☐ NON-AQUEOUS DISPERSIONS - RED CONTAINING LEAD

Daniel: AL625 "Quinacridone" Red
Alkytint^R S-5022 Lt. Molybdate Orange
Hilton-Davis: 5-42-A-123 Toluidine Red, Dark
other:

☐ NON-AQUEOUS DISPERSIONS - RED CONTAINING CADMIUM AND SELENIUM

Inmont: Cadmium Red - 5419, 5420
Chroma-Cal^R Cadmium Red 850-000-0601, 850-000-0801
Other:

☐ NON-AQUEOUS DISPERSIONS - YELLOW CONTAINING LEAD AND/OR CHROMIUM

Daniel: Chrome Yellow - AL 405, AL 409
Alkytint^R Chrome Yellow - S-536, S-5507
Hilton-Davis: Chrome Yellow - 5-24-A-200; 5-24-A-203; 5-24-A-206; 5-42-A-201; 5-42-A-206; 5-83-P-353; 5-21-P-212
Auracote^R Chrome Yellow 5-50-P-365
Inmont: Chrome Yellow 3,6; Medium Chrome Yellow 2347, 2612, 4904, 5413, 5414, 6258
Uni-Cal^R 66 - 6604M, 6665X
Chroma-Cal^R - 850-000-2006
Tenneco: Chrome Yellow - GPD 2006: GPD 2510
Other:

☐ NON-AQUEOUS DISPERSIONS - YELLOW (DICHLOROBENZIDENE DERIVED)

Inmont: Diarylide Yellow 1178, Transparent Yellow 1198
Other:

☐ NON-AQUEOUS DISPERSIONS - ORANGE CONTAINING LEAD AND/OR CHROMIUM

Daniel: Molybdate Orange: AL 615, UL 2069
Hilton-Davis: Chrome Orange 5-24-A-600; Orange Blend 5-24-A-609; Molybdate Orange 5-24-A-616, 5-42-A-612; 5-83-P-635, 5-42-A-615, 5-21-P-603
Auracote^R Molybdate Orange 5-50-R-639
Inmont: Molybdate Orange 840, 2377, 4905, 5415, 6264
Tenneco: Moly Orange GPD 0940
Chroma-Cal^R 850-000-0903
Other:

☐ NON-AQUEOUS DISPERSIONS - BLUE CONTAINING LEAD AND/OR CHROMIUM

Chemtron: "NCNF" FS-495; "NCNF" RS-957; "NCNF" RS-1197; "NCNF" RS-1795
Other:

☐ NON-AQUEOUS DISPERSIONS - GREEN CONTAINING LEAD AND/OR CHROMIUM

Alkytint^R Green S-310
Daniel UCS 10-72X
Tenneco: GPD-4202CP, GPD-4509 CP, GPD-4208, GPD-5103
Uni-Cal^R 66-6605
Other:

☐ NON-AQUEOUS DISPERSIONS - GREEN CONTAINING COPPER AND/OR CYANIDES

Hostaprint^R Green 16-2008
Chemetron: "Phthalo" Green FS-784; FS-958; FS-1192, FS 1794
Microlith^R Green G-A, G-T, G-K
Alkytint^R Green S-317
Daniel: "Phthalo" Green - AL 703, UL 20-77, UCS 10-70D, AC 66-78, UF 75-74, EP 30-71, PF 4750, AL 745, UL 20-79,
Hilton-Davis: "Phthalo" Green - 5-24-A-400, 5-24-A-405, 5-42-A-407, 5-42-A-411, 5-24-A-435 5-83-P-401, 5-42-A-400, 5-83-P-401, 5-21-P-441, 5-21-P-444, Chrome Gr. 5-24-A-406
Auracote^R Phthalo 5-65-A-427
Inmont: Chrome Green 1, 809; "Phthalo" Green 1083, 1168, 1199, 1245, 2330, 2610, 3035, 5412, 5447, 54;2
Podell: 2000 Series prefix AL, AN, ANE, AV, C, CS, CU, DU, LA, LC, S, VT, Y
Tenneco: GPD-5503, GPD-4508-LF, AD-5503
Uni-Cal^R 66 - 6611R
Chroma-Cal^R Green 850-000-5001
Other Non-Aqueous Dispersions - Green Containing Copper and/or Cyanides:

PIGMENTS, DYES, FLUSHES AND DISPERSIONS (Cont.)

☐ NON-AQUEOUS DISPERSION - BLUE CONTAINING COPPER AND/OR CYANIDES

Microlith^R Blue 4G-K, 4G-T, A3R-K
Alkytint^R 54215, 54557, S-182
Daniel: AL 201A, AL 281A, AL 296B, AC 66-27, UF 75-28,
EP 30-23, PF 4260, AL 297R, AL 298, UL 20-26,
UCS 10-20E
Hilton-Davis, "Chinese Blue" S-24-A-304, 302; "Phthalo
Blue - S-24-A-306, 304, 308, 309, 311,
S-21-P-335, 337, S-42-A-312, 305,
S-83-P-300,301
Auracota^R Blue S-65-A-395
Inmont: 1190, 1202, 1211, 2609, 5444, 5475, 3034,
4914, 1077, 4916, 9024, 2327, 5498, 6150,
Podell: 6000 Series prefix AL, AM, AME, AV, C, CS, DU,
LC, S, SR, SK, VT, Y
Tenneco: GPD-7308, 7209,
Uni-Cal^R 66 - 6608P, 6614U
Chroma-Cal^R - 850-000-7202
Other Non-Aqueous Dispersions - Blue Containing Copper and/or Cyanides:

☐ NON-AQUEOUS DISPERSIONS - BLUE CONTAINING SILVER

Alkytint^R 5448
Daniel: AL 221
Inmont: 6297
Tenneco: GPD 7504
Other:

CHEMICAL SPECIALTIES

☐ DRIERS CONTAINING LEAD

Shephard - Lead Tallates, Lead Linoleates,
"Hexogen", "Advasol", "Catalox", "Octasol", "Octoate",
Troychem^R, Troymax^R, Troykyd^R, Witco^R, Witcon^R,
"Hex-Cem", "Ten-Cem", "Tallate", "Nuolate", "Linoresinate",
"Lin-All", "Cem-All", "Intercar", "Cyclodex", "Noury-Dry",
"NED", "Neo-Nap", "NuXtra"
Other Driers Containing Lead:

☐ DRIERS CONTAINING ZINC

Shephard - Zinc Acetate, Zinc Tallates,
"Hexogen", "Catalox", "Octasol", "Octoate", Troymax^R
Witco^R, Witcon^R, "Hex-Cem", "Linoresinate", "Lin-All"
"Cem-All", "Noury-Dry", "NED", "Neo-Nap", "NuXtra",
Other Zinc Containing Driers:

☐ MISCELLANEOUS DRIERS

Shephard - Copper Linoleates: "Hexogen" - Copper Octoate;
"Advasol" - Copper: "Drytain-24"; "Neodecanoate";
"Hex-Cem" - Nickel; "Linoresinate" - Copper; "Nuact"

☐ DRIERS - NAPHTHENATE TYPE

Interstab Series, Ferro Series, "Nap-All" Series,
"Uversol" Series, "Nuodex" Series, Shephard Series,
Troykyd^R Series, Troysan^R Series, Witco^R Series
"Mooney" Series,
Other:

☐ METALLIC SOAPS AND FLATTING AGENTS CONTAINING ZINC

Aero No. 45 U.S.P.; Diamond "Zinc St. H", "Zinc St. USP",
"Zinc St. USP 603", "Zinc St. 639C"; Nuodex USP, DLG-10, DLG-20,
Technical; Plymouth XXX-M, SI-36, SI-50, No. 21;
Witco Regular, Lacquer Grade No. 3, NB-60; NB-70;
"Zinc Palmitate"
Other:

☐ METALLIC SOAPS AND FLATTING AGENTS CONTAINING LEAD

Diamond - Lead Stearate
Nuodex V-1 Precipitated, V2 Fused
Witco 30
Other:

☐ PLASTICIZERS CONTAINING DI-N-BUTYL PHTHALATE

Allied "Dibutyl Phthalate"
Amsco Dibutyl Phthalate
CSC - Dibutyl Phthalate
Kodaflex^R DBP HS4
Santicizer^R 213
NATCOL DBP
Nuoplaz^R DBP
Sherwin Williams CP-907
Phthalic Acid; Dibutyl Ester; Ortho-Benzene-Carboxylic Acid; Dibutyl Ester; Benzene-O-Dicarboxylic Acid DI-N-Butyl Ester; DI-N-Butyl Phthalate. "Celluflex DBP"; "DBP", "Elaol", "Hexaplas M/B; "Palatinolc"; "Polycizer DBP"; "PX-104"; "Staflex DBP"; "Witcizer 300"
Other Plasticizers containing DI-N-Butyl Phthalate:

☐ PLASTICIZERS CONTAINING DIMETHYL PHTHALATE

DMP
Kodaflex^R DMP
Methyl Phthalate, P4 Phthalic Acid Dimethylester
Others:

☐ PLASTICIZERS CONTAINING DIETHYL PHTHALATE

DEP
Amsco Diethyl Phthalate
Kodaflex^R DEP
Santicizer^R 885; Monsanto DEP
Formic Acid; Ethyl Ester; 1,2-Benzene Dicarboxylic Acid; Diethyl Ester; Ethyl Formic Ester; Phthalic Acid; Diethyl Ester; Ethyl Methanoate; Ethyl Phthalate; Formi Ether; "Anozol", "Areginal", "Neantine"; "Palatinol A"; "Phthalol"; "Placidole"; "Solvanol"
Other:

☐ PLASTICIZERS CONTAINING DI-2-ETHYLHEXYL PHTHALATE

DOP, Phthalic Acid, Di-Sec-Octyl-Phthalate
Jayflex DOP
Monsanto DOP
Kodaflex^R DOP, PX 138
Santicizer 215
Other

☐ PARAPLEX

RG-2(60%)
G-25 (70%)

☐ PLASTICIZERS CONTAINING BUTYL BENZYL PHTHALATE

BBP
Sacticizer 160
Phthalic Acid
N Butyl Benzyl Ester

☐ STABILIZERS CONTAINING LEAD

All Halstab Lead
All NL Lead
"Lead Stearate"
Other:

☐ STABILIZERS CONTAINING ZINC AND/OR CADMIUM

Interstab - BC-100S, BC-103, BC-103A, BC-103L,
BC-109, BC-110, BC-202, 761-28, 943-38, R-4023,
R-4025, 778-45, CZ-11, CZ-11D, CZ-19A, CZ-10, ABC-1
ABC-7,
Ferro - 651; 1238, 703; 1241, 707X; 1701, 763, 1720, 760X
1212A; 1776, 1237; 1777, 1827,, 5019, 1840, 5373,
2020; 5444, 2035; 5473, ZV4; 5918, ZV4; 5919, 6V2;
5930, 6V6A, 19V1, 5002, 59V11
"Nuostabe" - V1; V1218, V2; V1250, V12; V1255,
V133; V1277, V134; V1298, V152; V1399, V1026;
V1420, V1048; V1503, V1204; V1555, V1216; V1572
Other Stabilizers Containing Zinc and/or Cadmium:

CHEMICAL SPECIALTIES (Cont.)

☐ STABILIZERS CONTAINING LEAD OR PHENOL

Interstab LD-24
Troykyd® Anti-Skin Special Mod.
Anti-Skin Odorless
Other:

☐ WETTING AGENTS CONTAINING PHENOL

Diamond: "Nyonic" Series
Witco 936, 960, 980
Other:

☐ MISCELLANEOUS WETTING AGENTS

Aerosol® OS
Troysan® Zinc 8

☐ VISCOSITY SUSPENSION & FLOW CONTROL AGENTS CONTAINING TOLUENE

Pliolite® AC-3
Other:

☐ ANTI-SKINNING AGENTS CONTAINING PHENOLS

"Guaiacol Special C"; Troykyd® Antiskin Special Modified, Troykyd® Antiskin Odorless Liquid, Troykyd® Antiskin S; Nevillac® 10, TS
Other:

☐ PRESERVATIVES CONTAINING MERCURY

"Intercide" PMO 11%, PMA 18%, 60
Nuodex PMA-18, PMO-17
"Troysan" CMP Acetate, PMA10 SEP, CMP 10 SEP, PMO 30, PMB, Mercuric Oxide, PMA 30, PMA 100
"Super AD-It"
Other Preservatives Containing Mercury

☐ PRESERVATIVES CONTAINING COPPER

Interstab "Copper Naphthenate" 6%, 8%
"Intercide" Copper 10%
Insotrol® CQ-A, CQ-4R, CN8
"Nap-All" Copper Naphthenate
"Oversol" Copper Naphthenate
Troysan® Copper 8
Witco® Copper Naphthenate
Nuodex Copper Naphthenate
"Quindex"
Other Preservatives Containing Copper:

☐ PRESERVATIVES CONTAINING PENTACHLOROPHENOL (PCP)

Dowicide® G, EC-7
"Santobrite"
"Penta"
"Santophen-20"
"PCP"
Other PCP Preservatives

☐ PRESERVATIVES CONTAINING ZINC

"Interstab" Zinc Naphthenate 8%
"Troysan" Zinc 8
"Vancide" 51Z
"Nap-All" Zinc Naphthenate
"Oversol" Zinc Naphthenate
Witco Zinc Naphthenate
Other Zinc Preservatives:

☐ OTHER PRESERVATIVES

Dowicide® A

RESINS

☐ DRYING OIL MODIFIED ALKYD SOLUBLE IN OR CONTAINING NAPHTHALENE

Aroplaz® 310-M-50; "Coroc" L-26-84, S-47-84, S-4700-84; Reliance AL-4313-MA-50, AL-3617-MA-50, AL-4409-MA-60, AL-4313-MA-50,
Other:

☐ DRYING OIL MODIFIED ALKYD SOLUBLE IN OR CONTAINING TOLUENE OR ETHYLBENZENE

Koppers: 1530-27, 7365-XS-70
Reliance: AL 4310-T-50, AL 4323-T-60
"Synresate" D-30360-T, W-7170-T
Other:

☐ NON-DRYING & SEMI OXIDIZING OIL MODIFIED ALKYD SOLUBLE IN OR CONTAINING ETHYLBENZENE OR TOLUENE

Conchemco 123-010
Koppers 99-4, 99-XS-70; "Mirasol" 123-4-T, 131, 902, RCI-12-010, 12-021; Reliance AL-2107-TX-60, AL-2313-TXB-60, AL-4106-TX-75, AL-4129-T-60; "Synresate" W-7170-T
Other:

☐ RESIN MODIFIED ALKYDS SOLUBLE IN OR CONTAINING TOLUENE OR NAPHTHALENE

Aroplaz® 1031-T-70; "Mirasol" 214, 202-A; RCI 10-010; Reliance AL-3321-MA-50 Varkyd® 310-50MS
Other:

☐ COPOLYMER ALKYDS SOLUBLE IN OR CONTAINING TOLUENE OR NAPHTHALENE

"Chempol" 13-2444; "Synresate" D-8830-6, TP-134-GA; Reliance SY-2003-VT-50; "Kelpol" 3718-40X
Other:

☐ CELLULOSE RESINS SOLUBLE IN OR CONTAINING METHYL CHLORIDE OR TOLUENE

Eastman "CA" Series, CAB 381-0.1, CAB 381-0.5, CAB 381-20, CAB 451-1, CAP 482-0.5
Other:

☐ POLYESTER ALKYDS SOLUBLE IN OR CONTAINING TOLUENE OR NAPHTHALENE

Aroplaz® 6022-X-63, 6025-X-70, 6029-X-60; Cargill 6619/6619-70, 6620/6620-60; "Synresate" W8127OXB03, W87608
Other:

☐ EPOXY SOLUTIONS SOLUBLE IN OR CONTAINING TOLUENE

"EPI-REZ" - 2047; Araldite® 571-T-75, 597-KT-55, 597-XX-55, 597-CT-55; Dow D.E.R. 671-T75; GenEpoxy® 5167-75; Epotuf® 38-508, 38-507, 38-519
Epon® Resin 1001 BT 70, 1001 CX-75, 1001 FT-75, 1001 T-75 1007-CT-55, 1007-KT-55; Vanoxy® 201-T-75, 201-BT-70, 201-FT-75, 207-KT-55, 207-CT-55
Other Epoxy Solutions Soluble in or Containing Toluene:

☐ POLYAMIDES SOLUBLE IN OR CONTAINING TOLUENE

"CIBA Polyamide" 800IT60, 815T-70; "Crepolamid" L-100 IT; Emery "Emerez" 1500; Versamid® 400; Epotuf® 37-621, 37-648; Vanamid® 300 IT-60
Other:

☐ UREA RESINS SOLUBLE IN OR CONTAINING TOLUENE

Reliance AM-1008-IT-55, AM-1012-IT-55
Other:

☐ MELAMINE RESINS SOLUBLE IN OR CONTAINING NAPHTHALENE

Melmac® 243-3
Other:

☐ VINYL SOLIDS, PVC (SYNTHESIZED FROM VINYL CHLORIDE)

APCI "PVC" Series; Goodyear "Pliovic" Series;
UCC - VYHH; VYHC, VYHD; QYHW, VYLF; QYKV, VYNS; VLFV, VYNW; QYLV, VAGH; QYOH, VAGD; QYNL, VMCH; QYNJ, VMCC; E-2000; VMCA; VYDR, VROH; VYDR-44, VERR;
"Saran Resin" F310
Other Vinyl Solids, PVC:

RESINS (Cont.)

☐ POLYVINYL ACETATE (SYNTHESIZED FROM VINYL CHLORIDE)

Vinac® B7, B15, B25, B100, B800, ASB516
Other:

☐ POLYVINYL ALCOHOL, FORMAL & BUTYRAL SOLUBLE IN OR CONTAINING PHENOL OR TOLUENE

Formvar® Series; UCC XYHL, XYSG, XYNC, XYSM
Other:

☐ VINYL CHLORIDE & VINYLIDENE CHLORIDE

"Polyco" Series; "Saran Latex" 143; Polidene® Series
Other:

☐ ACRYLIC SOLIDS SOLUBLE IN OR CONTAINING TOLUENE

Acryloid® B48N, B50, B66, B67, B72, B82
Other:

☐ ACRYLIC SOLUTIONS SOLUBLE IN OR CONTAINING TOLUENE

Conchemco 311-405, 311-120; Elvacite® 6011, 6012, 6013, 6014, 6016, 6024; G Cure® 867 RMF 60, 868 RMF 60, 869 RMF 50; Acryloid® A-21, A-21LV, B-44, B-48N, B-50, B-66, B-72, B-82, B-84, B-99, C-10LV
Other:

☐ CHLORINATED RUBBERS SOLUBLE IN OR CONTAINING TOLUENE

Parlon® Series
Other:

☐ PHENOLIC RESINS

Arofene® Series; Amberol® ST-137, Super Beckacite® Series; Reichhold (V) 29-000, 100, 400 Series;
UCC CK-1282, CK-1634;
BKR-2620, BKR-2315, BKRC-2455, BKS-2600, BLS-2700, BKR-2750; Amberol® ST-149; UCC "CK" Series, CKRB-3001;
Pentalyn® Series; Nevillac® Series; "Synresol" Series;
"Shanco" Series
Other Phenolic Resins:

☐ STYRENE & VINYL TOLUENE SOLUBLE IN TOLUENE

Piccolastic® FT, Bronze Vehicle
Other:

☐ OLEORESINOUS VARNISHES SOLUBLE IN OR CONTAINING PHENOL OR ETHYLBENZENE

Conchemco 385-003; Tenneco 2-12B; McCloskey 12825-54 EMD, 10424-55E, 11233-55EMD, 11325-40 EMD, 739-41E, 10917-94EMD, 1633-50E, 1625-40E; Syncon CS-3-40, [illegible]EMD, 1335-56E, 11150-51MD, 10731-46E, 10931-28E, 2211-44E, 920-50EMD; Kelvar® C-631-40E, C-631-50M
Chempol® 13-1509, 13-1518; Nuvar® 1316, 1398; Syncon® Series, F-147, F-121, Flora, RLC.
"Lewtar" Series; "Superior" Series
Other Oleoresinous Varnishes Soluble in or Containing Phenol or Ethylbenzene

☐ SILICONES SOLUBLE IN OR CONTAINING TOLUENE OR NAPHTHALENE

UCC-R-12; Cargill 4106-40
Other:

☐ MALEIC SOLUTIONS SOLUBLE IN OR CONTAINING TOLUENE

Arochem® 530T; Syncon RA540T
Other:

☐ URETHANE RESINS SOLUBLE IN OR CONTAINING TOLUENE

"Spenkel" F78-50T, Spencer XP 1857; "Synresate" [illegible]
[illegible]; Spenlite® L61-301; Spencer IV "1000" Series
Other:

☐ MISCELLANEOUS SOLUBLE IN OR CONTAINING TOLUENE, METHYL CHLORIDE, OR TRICHLOROETHYLENE

Elvax® 40; "Vitel" PE207, PE207F, PE222, PE222F, PE307, PE307F, VPE5545A, VPE 5571A.; RCI 10-714
Other:

SOLVENTS

☐ BENZENE

Espesol® Benzene; Benzene (Nitration Grade)
"Benzol", "Cyclohexatriene" Coal Naphtha, Benzol Hydride,
Other:

☐ BENZENE AND TOLUENE MIXTURES:

Amsco "Solv"A, "Solv" A-60, "Solv" A-61, "Solv" A-100; Cyclosol® 27, 28; Espesol® 7200-A; Shelly SE-48
Other:

☐ TOLUENE

Espesol® 1° Toluene, 7200, Lactol Spirits
Toluol; Methyl-Benzene; Methacide Phenylmethane; Toluenol
Other:

☐ TOLUENE & ETHYLBENZENE MIXTURES

Amsco Solv B; Cyclosol® 37
Other:

☐ ETHYLBENZENE

Espesol® Ethylbenzene; Amsco "Super Hi-Flash Naphtha";
Shell TS-28
Phenylethane
Other:

☐ ISOPHORONE

3-5-5-Trimethyl-2-Cyclohexen-1-One

☐ CARBON TETRACHLORIDE

Dow "Dowclene" EC; Methane Tetrachloride;
Tetrachloromethane; Perchloromethane; Necatorina;
Benzinoform; "Necatorina"; "Benzinoform"

☐ CHLOROBENZENE

Monochloro-Benzene; Benzene-Chloride; Phenyl Chloride
Ashland Monochloro Benzene; Dow Monochloro Benzene
Other:

☐ 1,2,4 - TRICHLOROBENZENE

☐ 1,2 - DICHLOROETHANE

Ashland Ethylene Dichloride; Dow Ethylene Dichloride;
Olin Ethylene Dichloride
Other:

☐ 1,1,1 - TRICHLOROETHANE

Methylchloroform; 1-1-1-TCE; Chlorothene; Vinyl Trichloride; 1-1-1-Trichloroethane; 1-1-1 Trichloroethane
Dow "Chlorothene" NU; Chlorothene VG, NU;
α-Trichloroethane
"Triethane"; "Genklene"

☐ 1,1,2 - TRICHLOROETHANE

☐ bis (2-CHLOROETHYL) ETHER

Dichloroethyl Ether

☐ CHLOROFORM

Trichloromethane

☐ 1,2 - DICHLOROBENZENE

O-Dichlorobenzene; P-Dichlorobenzene
Dow Orthodichloro Benzene

☐ 1,2 DICHLOROPROPYLENE

Propylene Dichloride

SOLVENTS (Cont.)

☐ METHYLENE CHLORIDE

Methane Dichloride; Dichloromethane; Methylene Bichloride; Methylene Dichloride
Ashland Perchloroethylene; Dow Perchloroethylene
"Solaesthin"

☐ TRICHLOROETHYLENE

Trichloroethene; Ethinyl-Trichloride; Tri-Clene; Trielene; Trilene; Trichloran; Trichloren; Algylen; Trimar; Triline, Tri; Trethylen; Trethylene; Westrosol; Chlorylen; Gemalgene; Germalgen

☐ ETHYLENE DICHLORIDE

Dichloroethane; Glycol Dichloride; 1,2 Dichloroethane; Ethylene Chloride; Ethane-DC, B-Dichloride; "Brocide"; "Destruxol"; "Borer-Sol"; "Di-Chloro-Mulsion"; "Dutch Liquid"; "EDC"; "ENT 1, 656"

☐ PERCHLOROETHYLENE

Ethylene Tetrachloride; Tetrachloroethylene; Carbon-Dichloride; Didakene, Nema, Tetracap; Tetropil, Perclene, Ankilostin; "Dee-Solv"; "Per-Sec"; "Percosolv"; "Dow-Per"

☐ NAPHTHA (COAL TAR)

Benzin, 160°

Company Abbreviations Used

Alcan	- Aluminum Co. of Canada
Amsco	- Amsco Div. - Union Oil of California
APCI	- Air Products and Chemicals, Inc.
CSC	- Commercial Solvents Corp.
RCI	- Reichhold Chemicals Inc.
Reichhold (V)	- Varcum Chemical Division of Reichhold Chemicals
UCC	- Union Carbide Corp.

APPENDIX B

CROSS TABULATION OF AGE OF INK MANUFACTURING FACILITIES BY NUMBER OF EMPLOYEES

```
INK INDUSTRY SURVEY

FILE    INK     (CREATION DATE = 03/03/78)

* * * * * * * * * * * * * * * * * * * * *   C R O S S T A B U L A T I O N   O F
   Q56       WATER PRESSURE USED FOR WATER WASH                   BY  Q63
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

                          Tubs under 10 Gallons
                       Q63 Water Use Per Tub Rinsing  (Gal)
              COUNT  I
            ROW PCT  I11 TO 50 6 TO 10  0 TO 5       ROW
            COL PCT  I                               TOTAL
            TOT PCT  I  C      I  B      I  A      I
Q56         ---------I---------I---------I---------I
      C              I       0 I       0 I       1 I      1
  101 TO 150 PSI     I     0.0 I     0.0 I   100.0 I    1.0
                     I     0.0 I     0.0 I     1.2 I
                     I     0.0 I     0.0 I     1.0 I
                    -I---------I---------I---------I
      B              I       1 I       3 I      21 I     25
  51 TO 100 PSI      I     4.0 I    12.0 I    84.0 I   25.0
                     I    25.0 I    30.0 I    24.4 I
                     I     1.0 I     3.0 I    21.0 I
                    -I---------I---------I---------I
      A              I       3 I       7 I      64 I     74
  LESS THAN 50 PSI   I     4.1 I     9.5 I    86.5 I   74.0
                     I    75.0 I    70.0 I    74.4 I
                     I     3.0 I     7.0 I    64.0 I
                    -I---------I---------I---------I
             COLUMN          4        10        86      100
              TOTAL        4.0      10.0      86.0    100.0

* * * * * * * * * * * * * * * * * * * * *   C R O S S T A B U L A T I O N   O F
   Q56       WATER PRESSURE USED FOR WATER WASH                   BY  Q64
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

                          Tubs 10 to 50 Gallons
                       Q64  Water Use Per Tub Rinsing (Gal)
              COUNT  I
            ROW PCT  I51 TO 10 11 TO 50 6 TO 10  0 TO 5       ROW
            COL PCT  I0                                       TOTAL
            TOT PCT  I  D      I  C      I  B      I  A      I
Q56         ---------I---------I---------I---------I---------I
      C              I       0 I       0 I       0 I       1 I      1
  101 TO 150 PSI     I     0.0 I     0.0 I     0.0 I   100.0 I    0.7
                     I     0.0 I     0.0 I     0.0 I     1.0 I
                     I     0.0 I     0.0 I     0.0 I     0.7 I
                    -I---------I---------I---------I---------I
      B              I       1 I       3 I      13 I      19 I     36
  51 TO 100 PSI      I     2.8 I     8.3 I    36.1 I    52.8 I   25.0
                     I    50.0 I    21.4 I    40.6 I    19.8 I
                     I     0.7 I     2.1 I     9.0 I    13.2 I
                    -I---------I---------I---------I---------I
      A              I       1 I      11 I      19 I      76 I    107
  LESS THAN 50 PSI   I     0.9 I    10.3 I    17.8 I    71.0 I   74.3
                     I    50.0 I    78.6 I    59.4 I    79.2 I
                     I     0.7 I     7.6 I    13.2 I    52.8 I
                    -I---------I---------I---------I---------I
             COLUMN          2        14        32        96      144
              TOTAL        1.4       9.7      22.2      66.7    100.0
```

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INK INDUSTRY SURVEY

FILE    INK       (CREATION DATE = 03/03/78)

* * * * * * * * * * * * * * * * * * *   C R O S S T A B U L A T I O N   O F
     G56        WATER PRESSURE USED FOR WATER WASH                  BY  G65
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                           Tubs 51 to 100 Gallons
                       G65  Water Use Per Tub Rinsing (Gal)
                COUNT  I
              ROW PCT  IOVER 100 51 TO 10 11 TO 50 6 TO 10  0 TO 5      ROW
              COL PCT  I          0                                     TOTAL
              TOT PCT  I  E      I  D      I  C      I  B      I  A      I
G56           --------I--------I--------I--------I--------I--------I
         C             I      0  I      0  I      0  I      0  I      1  I      1
   101 TO 150 PSI      I    0.0  I    0.0  I    0.0  I    0.0  I  100.0  I    0.8
                       I    0.0  I    0.0  I    0.0  I    0.0  I    1.5  I
                       I    0.0  I    0.0  I    0.0  I    0.0  I    0.8  I
                      -I--------I--------I--------I--------I--------I
         B             I      1  I      1  I      6  I     14  I      8  I     30
   51 TO 100 PSI       I    3.3  I    3.3  I   20.0  I   46.7  I   26.7  I   23.1
                       I  100.0  I   33.3  I   24.0  I   38.9  I   12.3  I
                       I    0.8  I    0.8  I    4.6  I   10.8  I    6.2  I
                      -I--------I--------I--------I--------I--------I
         A             I      0  I      2  I     19  I     22  I     56  I     99
   LESS THAN 50 PSI    I    0.0  I    2.0  I   19.2  I   22.2  I   56.6  I   76.2
                       I    0.0  I   66.7  I   76.0  I   61.1  I   86.2  I
                       I    0.0  I    1.5  I   14.6  I   16.9  I   43.1  I
                      -I--------I--------I--------I--------I--------I
               COLUMN          1         3        25        36        65      130
               TOTAL         0.8       2.3      19.2      27.7      50.0    100.0

* * * * * * * * * * * * * * * * * * *   C R O S S T A B U L A T I O N   O F
     G56        WATER PRESSURE USED FOR WATER WASH                  BY  G66
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                           Tubs 101 to 250 Gallons
                       G66  Water Use Per Tub Rinsing (Gal)
                COUNT  I
              ROW PCT  IOVER 100 51 TO 10 11 TO 50 6 TO 10  0 TO 5      ROW
              COL PCT  I          0                                     TOTAL
              TOT PCT  I  E      I  D      I  C      I  B      I  A      I
G56           --------I--------I--------I--------I--------I--------I
         D             I      0  I      0  I      0  I      0  I      1  I      1
   OVER 150 PSI        I    0.0  I    0.0  I    0.0  I    0.0  I  100.0  I    1.0
                       I    0.0  I    0.0  I    0.0  I    0.0  I    2.6  I
                       I    0.0  I    0.0  I    0.0  I    0.0  I    1.0  I
                      -I--------I--------I--------I--------I--------I
         B             I      0  I      2  I     14  I      8  I      6  I     30
   51 TO 100 PSI       I    0.0  I    6.7  I   46.7  I   26.7  I   20.0  I   30.0
                       I    0.0  I   50.0  I   38.9  I   38.1  I   15.8  I
                       I    0.0  I    2.0  I   14.0  I    8.0  I    6.0  I
                      -I--------I--------I--------I--------I--------I
         A             I      1  I      2  I     22  I     13  I     31  I     69
   LESS THAN 50 PSI    I    1.4  I    2.9  I   31.9  I   18.8  I   44.9  I   69.0
                       I  100.0  I   50.0  I   61.1  I   61.9  I   81.6  I
                       I    1.0  I    2.0  I   22.0  I   13.0  I   31.0  I
                      -I--------I--------I--------I--------I--------I
               COLUMN          1         4        36        21        38      100
               TOTAL         1.0       4.0      36.0      21.0      38.0    100.0
```

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INK INDUSTRY SURVEY

FILE    INK      (CREATION DATE = 03/03/78)

* * * * * * * * * * * * * * * * * * * * * *  C R O S S T A B U L A T I O N   O F   *
    Q56        WATER PRESSURE USED FOR WATER WASH                    BY  Q67          WATF
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                             Tubs 251 to 500 Gallons
                         Q67  Water Use Per Tub Rinsing (Gal)
                COUNT  I
              ROW PCT  IOVER 100 51 TO 10 11 TO 50 6 TO 10  0 TO 5        ROW
              COL PCT  I          0                                        TOTAL
              TOT PCT  I  E       I  D       I  C       I  B       I  A       I
Q56           --------I---------I---------I---------I---------I---------I
         D             I       0 I       0 I       0 I       0 I       1 I       1
   OVER 150 PSI        I     0.0 I     0.0 I     0.0 I     0.0 I   100.0 I     1.8
                       I     0.0 I     0.0 I     0.0 I     0.0 I     3.7 I
                       I     0.0 I     0.0 I     0.0 I     0.0 I     1.8 I
                      -I---------I---------I---------I---------I---------I
         B             I       0 I       1 I       6 I       2 I       7 I      16
   51 TO 100 PSI       I     0.0 I     6.3 I    37.5 I    12.5 I    43.8 I    28.1
                       I     0.0 I    25.0 I    46.2 I    18.2 I    25.9 I
                       I     0.0 I     1.8 I    10.5 I     3.5 I    12.3 I
                      -I---------I---------I---------I---------I---------I
         A             I       2 I       3 I       7 I       9 I      19 I      40
   LESS THAN 50 PSI    I     5.0 I     7.5 I    17.5 I    22.5 I    47.5 I    70.2
                       I   100.0 I    75.0 I    53.8 I    81.8 I    70.4 I
                       I     3.5 I     5.3 I    12.3 I    15.8 I    33.3 I
                      -I---------I---------I---------I---------I---------I
                COLUMN         2         4        13        11        27        57
                 TOTAL       3.5       7.0      22.8      19.3      47.4     100.0

* * * * * * * * * * * * * * * * * * * * * *  C R O S S T A B U L A T I O N   O F   *
    Q56        WATER PRESSURE USED FOR WATER WASH                    BY  Q68          WATE
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                             Tubs 501 to 1000 Gallons
                         C68 Water Use Per Tub Rinsing (Gal)
                COUNT  I
              ROW PCT  IOVER 100 51 TO 10 11 TO 50 6 TO 10  0 TO 5        ROW
              COL PCT  I          0                                        TOTAL
              TOT PCT  I  E       I  D       I  C       I  B       I  A       I
Q56           --------I---------I---------I---------I---------I---------I
         B             I       0 I       3 I       2 I       0 I       5 I      10
   51 TO 100 PSI       I     0.0 I    30.0 I    20.0 I     0.0 I    50.0 I    34.5
                       I     0.0 I    60.0 I    66.7 I     0.0 I    26.3 I
                       I     0.0 I    10.3 I     6.9 I     0.0 I    17.2 I
                      -I---------I---------I---------I---------I---------I
         A             I       1 I       2 I       1 I       1 I      14 I      19
   LESS THAN 50 PSI    I     5.3 I    10.5 I     5.3 I     5.3 I    73.7 I    65.5
                       I   100.0 I    40.0 I    33.3 I   100.0 I    73.7 I
                       I     3.4 I     6.9 I     3.4 I     3.4 I    48.3 I
                      -I---------I---------I---------I---------I---------I
                COLUMN         1         5         3         1        19        29
                 TOTAL       3.4      17.2      10.3       3.4      65.5     100.0
```

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INK INDUSTRY SURVEY

FILE   INK      (CREATION DATE = 03/03/78)

* * * * * * * * * * * * * * * * * * * *  C R O S S T A B U L A T I O N   O F
   G56       WATER PRESSURE USED FOR WATER WASH                    BY  G69
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                              Tubs over 1000 Gallons
                     G69  Water Use Per Tub Rinsing (Gal)
            COUNT   I
            ROW PCT IOVER 100 51 TO 10 11 TO 50 0 TO 5      ROW
            COL PCT I          0                            TOTAL
            TOT PCT I  E      I  D      I  C      I  A      I
G56         --------I--------I---------I---------I---------I
        8           I      1  I      1  I      0  I      6  I      8
  51 TO 100 PSI     I   12.5  I   12.5  I    0.0  I   75.0  I   42.1
                    I   50.0  I  100.0  I    0.0  I   42.9  I
                    I    5.3  I    5.3  I    0.0  I   31.6  I
                   -I---------I---------I---------I---------I
        A           I      1  I      0  I      2  I      8  I     11
  LESS THAN 50 PSI  I    9.1  I    0.0  I   18.2  I   72.7  I   57.9
                    I   50.0  I    0.0  I  100.0  I   57.1  I
                    I    5.3  I    0.0  I   10.5  I   42.1  I
                   -I---------I---------I---------I---------I
           COLUMN          2         1.         2        14       19
            TOTAL       10.5       5.3       10.5      73.7    100.0
```

APPENDIX C

CROSS TABULATION OF AMOUNT OF WATER USED TO RINSE INK TUB BY WATER PRESSURE OF RINSE WATER

```
INK INDUSTRY SURVEY

FILE   INK      (CREATION DATE = 03/07/78)

* * * * * * * * * * * * * * * * * * *  C R O S S T A B U L A T I O N   O F   *
   Q8          AVERAGE NUMBER OF EMPLOYEES                     BY  Q10        AGE
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

NUMBER OF                Q10          AGE OF MANUFACTURING
EMPLOYEES                               FACILITIES (YEARS)
              COUNT    I
              ROW PCT  IOVER 30  21 TO 30  11 TO 20  6 TO 10   3 TO 5   LESS THA   ROW
              COL PCT  IYEARS                                          N 3        TOT
              TOT PCT  I  F      I  E      I  D      I  C      I  B      I  A      I
Q8            ---------I---------I---------I---------I---------I---------I---------I
                L      I      1  I      0  I      2  I      1  I      0  I      0  I     4
  OVER 150             I   25.0  I    0.0  I   50.0  I   25.0  I    0.0  I    0.0  I    0
                       I    1.6  I    0.0  I    1.6  I    1.0  I    0.0  I    0.0  I
                       I    0.2  I    0.0  I    0.4  I    0.2  I    0.0  I    0.0  I
                      -I---------I---------I---------I---------I---------I---------I
                K      I      8  I      0  I      1  I      0  I      0  I      0  I
  101 TO 150           I   88.9  I    0.0  I   11.1  I    0.0  I    0.0  I    0.0  I   2.0
                       I   12.5  I    0.0  I    0.8  I    0.0  I    0.0  I    0.0  I
                       I    1.8  I    0.0  I    0.2  I    0.0  I    0.0  I    0.0  I
                      -I---------I---------I---------I---------I---------I---------I
                J      I      2  I      1  I      0  I      0  I      0  I      0  I     3
  91 TO 100            I   66.7  I   33.3  I    0.0  I    0.0  I    0.0  I    0.0  I    0
                       I    3.1  I    1.7  I    0.0  I    0.0  I    0.0  I    0.0  I
                       I    0.4  I    0.2  I    0.0  I    0.0  I    0.0  I    0.0  I
                      -I---------I---------I---------I---------I---------I---------I
                I      I      3  I      0  I      1  I      0  I      0  I      0  I
  81 TO 90             I   75.0  I    0.0  I   25.0  I    0.0  I    0.0  I    0.0  I   0.7
                       I    4.7  I    0.0  I    0.8  I    0.0  I    0.0  I    0.0  I
                       I    0.7  I    0.0  I    0.2  I    0.0  I    0.0  I    0.0  I
                      -I---------I---------I---------I---------I---------I---------I
                H      I      1  I      1  I      1  I      0  I      0  I      0  I     3
  71 TO 80             I   33.3  I   33.3  I   33.3  I    0.0  I    0.0  I    0.0  I   0 7
                       I    1.6  I    1.7  I    0.8  I    0.0  I    0.0  I    0.0  I
                       I    0.2  I    0.2  I    0.2  I    0.0  I    0.0  I    0.0  I
                      -I---------I---------I---------I---------I---------I---------I
                G      I      1  I      0  I      3  I      0  I      1  I      0  I
  61 TO 70             I   20.0  I    0.0  I   60.0  I    0.0  I   20.0  I    0.0  I    1
                       I    1.6  I    0.0  I    2.4  I    0.0  I    2.0  I    0.0  I
                       I    0.2  I    0.0  I    0.7  I    0.0  I    0.2  I    0.0  I
                      -I---------I---------I---------I---------I---------I---------I
                F      I      0  I      0  I      2  I      0  I      0  I      1  I     3
  51 TO 60             I    0.0  I    0.0  I   66.7  I    0.0  I    0.0  I   33.3  I   0.7
                       I    0.0  I    0.0  I    1.6  I    0.0  I    0.0  I    2.0  I
                       I    0.0  I    0.0  I    0.4  I    0.0  I    0.0  I    0.2  I
                      -I---------I---------I---------I---------I---------I---------I
              COLUMN         64        60       126        98        50        49     44
              TOTAL        14.3      13.4      28.2      21.9      11.2      11.0   100.
(CONTINUED)
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INK INDUSTRY SURVEY

FILE    INK      (CREATION DATE = 03/07/78)

* * * * * * * * * * * * * * * * * * * * * * * *  C R O S S T A B U L A T I O N   O F  * *
   G8          AVERAGE NUMBER OF EMPLOYEES                              BY  G10         AGE
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

NUMBER OF                  Q10            AGE OF MANUFACTURING
EMPLOYEES        COUNT    I                  FACILITIES (YEARS)
                 ROW PCT  IOVER 30  21 TO 30 11 TO 20 6 TO 10   3 TO 5   LESS THA   ROW
                 COL PCT  IYEARS                                         N 3       TOTAL
                 TOT PCT  I  F      I  E      I  D      I  C      I  B      I  A      I
Q8               --------I--------I--------I--------I--------I--------I--------I
        E                 I      2 I      0 I      6 I      2 I      2 I      1 I     13
   41 TO 50               I   15.4 I    0.0 I   46.2 I   15.4 I   15.4 I    7.7 I    2.9
                          I    3.1 I    0.0 I    4.8 I    2.0 I    4.0 I    2.0 I
                          I    0.4 I    0.0 I    1.3 I    0.4 I    0.4 I    0.2 I
                         -I--------I--------I--------I--------I--------I--------I
        D                 I      3 I      4 I      6 I      9 I      2 I      1 I     25
   31 TO 40               I   12.0 I   16.0 I   24.0 I   36.0 I    8.0 I    4.0 I    5.6
                          I    4.7 I    6.7 I    4.8 I    9.2 I    4.0 I    2.0 I
                          I    0.7 I    0.9 I    1.3 I    2.0 I    0.4 I    0.2 I
                         -I--------I--------I--------I--------I--------I--------I
        C                 I     16 I      9 I     18 I     10 I      2 I      3 I     58
   21 TO 30               I   27.6 I   15.5 I   31.0 I   17.2 I    3.4 I    5.2 I   13.0
                          I   25.0 I   15.0 I   14.3 I   10.2 I    4.0 I    6.1 I
                          I    3.6 I    2.0 I    4.0 I    2.2 I    0.4 I    0.7 I
                         -I--------I--------I--------I--------I--------I--------I
        B                 I     13 I     29 I     29 I     30 I     14 I     13 I    128
   10 TO 20               I   10.2 I   22.7 I   22.7 I   23.4 I   10.9 I   10.2 I   28.6
                          I   20.3 I   48.3 I   23.0 I   30.6 I   28.0 I   26.5 I
                          I    2.9 I    6.5 I    6.5 I    6.7 I    3.1 I    2.9 I
                         -I--------I--------I--------I--------I--------I--------I
        A                 I     14 I     16 I     57 I     46 I     29 I     30 I    192
   LESS THAN 10           I    7.3 I    8.3 I   29.7 I   24.0 I   15.1 I   15.6 I   43.0
                          I   21.9 I   26.7 I   45.2 I   46.9 I   58.0 I   61.2 I
                          I    3.1 I    3.6 I   12.8 I   10.3 I    6.5 I    6.7 I
                         -I--------I--------I--------I--------I--------I--------I
                 COLUMN        64       60      126       98       50       49      447
                  TOTAL      14.3     13.4     28.2     21.9     11.2     11.0    100.0
```

APPENDIX D

PROCEDURES FOR METALS ANALYSIS BY INDUCTIVELY COUPLED ARGON PLASMA

Determination of Total Metals in Water
and Wastewaters by Plasma Spectrometry
CRL Method Nos. 504-570

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Scope and Application

This procedure is applicable to the determination of calcium, magnesium, sodium, potassium, aluminum, barium, berylium, boron, cadmium, chromium, cobalt , copper, lead, manganese, molybdenum, nickel, silver, thallium, tin, titanium, vanadium, ytrium and zinc in water and industrial municipal wastewaters.

Summary of Method

The sample is digested with 8 N nitric acid to near dryness followed by additional heating with HCl to solubilize transition and noble metals. The sample is cooled, diluted to 50 ml and analyzed using Inductively Coupled Argon Plasma Atomic Emission Spectrometry (ICAP). The alkali metals concentrations are expressed in milligrams per liter, whereas concentrations for other metals are expressed in micrograms per liter. Twenty-two metals are routinely analyzed.

Equipment

Jarrell Ash Atomcomp 750. Inductively coupled argon plasma emission spectrometer consisting of:

a. RF generator

b. Plasma housing

    1. Water-cooled induction coil
    2. Quartz torch
    3. Cross-flow nebulizer
    4. Spray chamber

c. Direct reading spectrometer

    1. Entrance slit
    2. Refractor plate at entrance slit
    3. Grating
    4. Exit slits
    5. Phototubes.

d. Computer for instrument control

e. Data output device.

300 ml tall form beakers
Mettler PR 700 Balance
Corning Hot Plates

Reagents, Water, Glassware and Standards

Redistilled Nitric Acid (1:1-8 Normal).
Hydrochloric Acid (1:1), Reagent Grade.

Glassware: Beakers for digestion, after being run through diswasher, are rinsed with distilled water and placed in an aqua regia bath for at least two hours. They are then rinsed thoroughly and allowed to air dry. The chemist performing the digestion will select his or her beakers and give each a hot acid wash by following then with 1:1 HCl and placing on the hot plate for at least one half hour.

The laboratory distilled water is passed through an ultrapure mixed-bed resin column before use. All water used unless otherwise stated, has been passed through the mixed-bed resin (Super Q Water).
Standards: All standards are diluted from Fisher 1000 ppm Atomic Absorption standards with the exception of silver and beryllium (varian) and Yytrium (made from ytrium nitrate (Y(NO3)3).
Standards used for the ICAP Calibration Procedure

S000: Mixed-bed resin water (super Q water)
S001: One ppm in all elements except silver and calcium
AGCA: 1 ppm silver and 10 ppm calcium, made fresh daily.
1000: 1000 ppm calcium (Fisher)
XXXX: 1000 ppm iron (Fisher), FFFA matrix only.

ocedure

1. A designated aliquot (usually 50 ml) of well-shaken and preserved sample (pH<2) is poured off into a 300 ml tall-form beaker. Normal procedure is to place the beaker on an automatic-tare balance and deliver 50 g - drawing off excess with a disposable pipet. (This procedure assumes the sample is of sufficiently low concentration that the specific gravity is not appreciably greater than one. The purpose of a mass determination rather than a volume one is to eliminate cross-contamination). After the addition of 6 ml of 8N redistilled HNO3, to the sample a ribbed beaker cover is placed on the beaker and the sample is heated to near dryness. (The sample is not taken to complete dryness to avoid the loss of boron). If the residue is dark colored after cooling, an additional 6 ml of 8N HNO3 is added and the sample is reheated. This process is continued until no color change is detected.

2. Following the digestion, 5 ml of 1:1 HCl is added and the residue is dissolved and/or placed in suspension by warming on a hot plate. After cooling, the sample is transferred to a pre-tared 2 ounce polyethylene bottle and diluted up to 50 g. If some solids remain undissolved, the sample is filtered into a 50 ml volumetric and then transferred to a polyethylene bottle for subsequent analysis.

3. Operating Conditions

   a. Incident RF power 1.1 kw
   b. Reflected RF power minimized (<10 w)
   c. Plasma observation height 15 mm above load coil
   d. Horizontal observation position...center
   e. Aspiration Argon flow rate 0.6 L/min
   f. Plasma Argon flow rate 22 L/min

4. ICAP Standardization Procedure and Sample Analysis.

Following startup, the instrument is profiled with the mercury monitor. The micrometer reading is recorded on the sheet with the interelement correction values for the day.

The matrix is brought onto core and time and date established. The available matrices are:

CCAS: correction for calcium
FEAS: correction for calcium and iron
K1AS: correction for calcium and iron and outputs potassium.

The Q-string QEGGGAB is set for standization. This string of commands will erase the burn buffers, execute three burns, average them, and print the average on the teletype.

(It has been found that examining the standards in background mode allows a better judgement of the noise in a given channel).

5. The standards cited above are run. Once it has been verified that the standards check, the values for interelement correction for iron and calcium are recorded and entered via the data base manager. In actual operation it is possible that these may vary only slightly (5%) from day to day, in which case they need not be entered.

Upon return to the operating system, the matrix is recalled and the blank and 1 ppm standard are checked. If these remain with in standardzation, an instrument AQC solution is measured. This AQC solution is simply the waste from the drain of the nebulizer, collected and held until it is deemed stable. The values for this solution are recorded in a log book and compared with previous values. This is a check for gross operator error during standardzation.

6. Once these criteria have been satisfied, the instrument is ready to run samples. The blank and 1 ppm standard should be checked every 30-45 min to establish that the instrument has not drifted. The blank should also be checked if values above detection limits are found for the field blanks or digested laboratory blanks.

7. Samples are aspirated for 45 seconds before executing the Q string QEGC which perform a single burn followed by output in concentration mode which includes interelement corrections. Longer flush times, may be desired for samples which follow high (>500 ppm) iron samples or high (>1000 ppm) sodium samples. No other elements have been encountered in sufficient quantities in real samples to result in noticeable memory effects.

8. Duplicates and spikes should be checked against the corresponding samples before continuing. This is to establish whether deviations occur in the digestion or measurement of samples on the ICAP. If it is found that the digestion is not at fault, restandardization on the ICAP is recommended.

9. Samples at high levels are routinely diluted 10-fold to determine if results for all elements are valid or the result of intererence not accounted for by the matrix IECC's.

   The paper tape from the teletype is read into the DG NOVA and the report plus QC check is performed by programs written in BASIC.

Quality Control

Four types of quality control samples are put through the digestion process at the same time as the samples. In a typical run of forty samples there are in addition, four blanks, 4 AQC solutions, 2 duplicates, 2 spikes.

1. Blanks: These are simply the laboratory super Q water carried through the same digestion process as the samples. The blank data is summarized periodically and is used to determine detection limits for the method (average and 2 standard deviations).

2. AQC Solutions: A series of solutions were made to cover the ranges measured for each parameter. These were arranged in Youden pairs approximately as follows: 10 ppm - 8 ppm; 1 ppm - 800 ppb; 100 ppb - 80 ppb. Two pairs of these solutions are digested as part of the run. This is separate from the instrument AQC and calibration procedure mentioned earlier.

3. Duplicates: Two samples are chosen to be analyzed as duplicates are carried through the digestion process. The results for these are expected to be within 10% of each other for each element, for concentrations in the working range (blank one + 10 standard deviations).

4. Spikes: Two samples are chosen to be analyzed as spikes. A table of spike concentrations in terms of final concentrations is formulated Spike recoveries are determined if the sample is less than 200% of the added spike.

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Routine Maintainance

Following four days of operation the torch and nebulization spray chamber should be acid washed. Before the torch is removed and after it is replaced, statistical programs are run to determine the standard deviation of all the lines when aspirating blank water. Dark currents are also examined in this manner. A reading of the profile meter is taken for each element both before and after cleaning while aspirating both blank water and the 1 ppm standard. When the torch is replaced, coarse alignment is made using a 1000 ppm yttrium standard to center the image on the slit. Fine adjustment of the mirror is made by maximizing the signal to noise ratio on the lead line.

Once a month, statistical programs are run to maintain an historical record of intensities obtained on each line for the series of standards.

Calculations

These are done by the computer program (written in basic) including insertion of dilution factors to give results in mg/l for calcium, magnesium and sodium and ug/l for the other metals.

Reference

1. Manual of "Methods for Chemical Analysis of Water and Wastes", U.S. Environmental Protection Agency, Office of Technology Transfer, 1974, Washington, DC, pp 78-155.

2. "Simultaneous Multielement Analysis of Liquid Samples by Inductively Coupled Argon Plasma Atomic - Emission spectroscopy", U.S. Environmental Protection Agency. Region V, Central Regional Laboratory, Chicago, Illinois, (unpublished).

	Name	in nm		Name	λ in nm
Ag	Silver	328.1	Mg	Magnesium	279.6
Al	Aluminum	396.2	Mn	Manganese	257.6
B	Boron	249.7	Mo	Molybdenum	203.8
Ba	Barium	233.5	Ni	Nickel	341.5
Ca(1)	Calcium	393.4	Pb	Lead	220.3
Ca(2)	Calcium	364.4			
Cd	Cadmium	226.5	Sn	Tin	190.0
Co	Cobalt	238.9	Ti	Titanium	334.7
Cr	Chromium	267.7	V	Vanadium	309.3
Cu	Copper	324.8	Y	Yttrium	417.8
Fe	Iron	259.5	Zn	Zinc	213.9

ELEMENT LIST AND ANALYTICAL LINES

TABLE I

A list of the elements currently analyzed by the CRL ICAP-AES instrument and the emission line chosen for each element.

	D.L. µg/l	LQD µg/l		D.L. µg/l	LQD µg/l
Ag	4	20	Mg	<0.5	1
Al	7	35	Mn	1	5
d	3	15	Mo	5	25
Ba	1	5	Ni	15	75
Ca	<0.5	1	Pb	12	60
Cd	2	10	Sn	12	60
Co	4	20	Ti	1	5
Cr	1	5	V	1	5
Cu	1	5	Y	~1	5
Fe	2	10	Zn	1	5

*Five Runs over Three Months

MEAN* DETECTION LIMITS

AND LOWEST QUANTITATIVELY DETERMINABLE CONCENTRATIONS (LQD)

TABLE 2

The detection limit (D.L.) is the amount of material that will produce a signal that is twice as large as the standard deviation of the noise. The lowest quantitative determinable concentration (LQD) is 5 times the D.L. and is the lowest concentration one can expect to report.

APPENDIX E

LIST OF PRIORITY POLLUTANTS

APPENDIX E

List of 129 Priority Pollutants

Compound Name

1. *acenaphthene
2. *acrolein
3. *acrylonitrile
4. *benzene
5. *benzidine
6. *carbon tetrachloride (tetrachloromethane)

*Chlorinated benezenes (other than dichlorobenzenes)

7. chlorobenezene
8. 1,2,4-trichlorobenzene
9. hexachlorobenzene

*Chlorinated ethanes (including 1,2-dichloroethane, 1,1,1-trichloroethane and hexachloroethane)

10. 1,2-dichloroethane
11. 1,1,1-trichloroethane
12. hexachloroethane
13. 1,1-dichloroethane
14. 1,1,2-trichloroethane
15. 1,1,2,2-tetrachloroethane
16. chloroethane

*Chloroalkyl ethers (chloromethyl, chloroethyl and mixed ethers)

17. bis(chloromethyl) ether

*Specific compounds and chemical classes as listed in the consent degree.

18. bis(2-chloroethly) ether

19. 2-chloroethyl vinyl ether (mixed)

*Chlorinated naphtalene

20. 2-chloronaphthalene

*Chlorinated phenols (other than those listed elsewhere; includes trichlorophenols and chlorinated cresols)

21. 2,4,6-trichlorophenol

22. parachlorometa cresol

23. *chloroform (trichloromethane)

24. *2-chlorophenol

*Dichlorobenzenes

25. 1,2-dichlorobenzene

26. 1,3-dichlorobenzene

27. 1,4-dichlorobenzene

*Dichlorobenzidine

28. 3,3'-dichlorobenzidine

*Dichloroethylenes (1,1-dichloroethylene and 1,2-dichloroethylene)

29. 1,1-dichloroethylene

30. 1,2-trans-dichloroethylene

31. *2,4-dichlorophenol

*Dichloropropane and dichloropropene

32. 1,2-dichloropropane

33. 1,2-dichloropropylene (1,3-dichloropropene)

34. *2,4-dimethylphenol

*Dinitrotoluene

35. 2,4-dinitrotoluene

36. 2,6,-dinitrotoluene

37. *1,2-diphenylhydrazine

38. *ethylbenzene

39. *fluoranthene

*Haloethers (other than those listed elsewhere)

40. 4-chlorophenyl phenyl ether

41. 4-bromophenyl phenyl ether

42. bis(2-chloroisopropyl) ether

43. bis(2-chloroethoxy) methane

*Halomethanes (other than those listed elsewhere)

44. methylene chloride (dichloromethane)

45. methyl chloride (chloromethane)

46. methyl bromide (bromomethane)

47. bromoform (tribromomethane)

48. dichlorobromomethane

49. trichlorofluoromethane

50. dichlorodifluoromethane

51. chlorodibromomethane

52. *hexachlorobutadiene

53. *hexachlorocyclopentadiene

54. *isophorone

55. *naphthalene

56. *nitrobenzene

*Nitrophenols (including 2,4-dinitrophenol and dinitrocresol)

57. 2-nitrophenol

58. 4-nitrophenol

59. *2,4-dinitrophenol

60. 4,6-dinitro-o-cresol

*Nitrosamines

61. N-nitrosodimethylamine

62. N-nitrosodiphenylamine

63. N-nitrosodi-n-propylamine

64. *pentachlorophenol

65. *phenol

*Phthalate esters

66. bis(2-ethylhexyl) phthalate

67. butyl benzyl phthalate

68. di-n-butyl phthalate

69. di-n-octyl phthalate

70. diethyl phthalate

71. dimethyl phthalate

*Polynuclear aromatic hydrocarbons

72. benzo(a)anthracene (1,2-benzanthracene)

73. benzo (a) pyrene (3,4-benzopyrene)

74. 3,4-benzofluoranthene

75. benzo(k)fluoranthane (11,12-benzofluoranthene)

76. chrysene

77. acenaphthylene

78. anthracene

79. benzo(ghi)perylene (1,12-benzoperylene)

80. fluroene

81. phenathrene

82. dibenzo (a,h)anthracene (1,2,5,6-dibenzanthracene)

83. indano (1,2,3-cd)pyrene (2,3-o-phenylenepyrene)

84. pyrene

85. *tetrachloroethylene

86. *toluene

87. *trichloroethylene

88. *vinyl chloride (chloroethylene)

Pesticides and Metabolites

89. *aldrin

90. *dieldrin

91. *chlordane (technical mixture & metabolites)

*DDT and metabolites

92. 4,4'-DDT

93. 4,4'-DDE (p,p'-DDX)

94. 4,4'-DDD (p,p'-TDE)

*endosulfan and metabolites

95. a-endosulfan-Alpha

96. b-endosulfan-Beta

97. endosulfan sulfate

*endrin and metabolites

98. endrin

99. endrin aldehyde

*heptachlor and metabolites

100. heptachlor

101. heptachlor epoxide

*hexachlorocyclohexane (all isomers)

102. a-BHC-Alpha

103. b-BHC-Beta

104. r-BHC (lindane)-Gamma

105. g-BHC-Delta

*polychlorinated biphenyls (PCB's)

106. PCB-1242 (Arochlor 1242)

107. PCB-1254 (Arochlor 1254)

108. PCB-1221 (Arochlor 1221)

109. PCB-1232 (Arochlor 1232)

110. PCB-1248 (Arochlor 1248)

111. PCB-1260 (Arochlor 1260)

112. PCB-1016 (Arochlor 1016)

113. *Toxaphene

114. *Antimony (Total

115. *Arsenic (Total)

116. *Asbestos (Fibrous)
117. *Beryllium (Total)
118. *Cadmium (Total)
119. *Chromium (Total)
120. *Copper (Total)
121. *Cyanide (Total)
122. *Lead (Total)
123. *Mercury (Total)
124. *Nickel (Total)
125. *Selenium (Total)
126. *Silver (Total)
127. *Thallium (Total)
128. *Zinc (Total)
129. **2,3,7,8 - tetrachlorodibenzo-p-dioxin (TCDD)

*Specific compounds and chemical classes as listed in the consent degree.

**This compound was specifically listed in the consent degree. Because of the extreme toxicity (TCDD). We are recommending that laboratories not acquire analytical standard for this compound.

APPENDIX F

LIST OF SAMPLING CANDIDATES

APPENDIX F

LIST OF SAMPLING CANDIDATES

CATEGORY 1 - Paste Ink Only

Capitol Printing Ink Co.
806 Channing Place, NE
Washington, DC 20018

Inmont Corporation
4700 Paddock Rd.
Cincinnati, OH 45229

CATEGORY 2 - Paste Ink Plus Water Flexo

Braden-Sutphin Ink Co.
3650 E. 93rd St.
Cleveland, OH 44105

Morrison Printing Ink Co.
4801 W. 160th Street
Cleveland, OH 44135

Wikoff Color Corp.
410 So. Gardner Ave.
Charlotte, NC 28208

Roberts & Porter, Inc.
1001 Morse Ave.
Elk Grove Village, IL 60007

CATEGORY 3 - Liquid Inks - mostly solvent, some water

C P & W Printing Ink Co.
3389 Powers Avenue
Jacksonville, FL 32217

American Inks & Coatings
P. O. Box 217
Volley Forge, PA 19481

Richardson Ink Co.
3901 W. Rohr Ave.
Milwaukee, WI 53209

J. M. Huber Corp.
Raritan Center
Edison, NJ 08817

Thiele Engdahl
6699 Winthrop Street
Addison, IL 60101

CATEGORY 4 - Paste Inks, Liquid Inks - broad product mix - (heterogeneous)

Flint Ink Corp.
25111 Glendale Ave.
Detroit, MI 48239

A. J. Daw Printing Ink Co.
3559 So. Greenwood Ave.
Los Angeles, CA 90040

Sinclair & Valentine Co.
5560 Doolittle Rd.
Jacksonville, FL 32205

Sun Chemical Corp.
3301 Hunting Park Ave.
Philadelphia, PA 19132

CATEGORY 5 - Speciality

Colonial Printing Ink Co.
180 E Union Ave.
E. Rutherford, NJ 07073

K. C. Coatings
500 Railroad Ave.
N. Kansas City, MO 64116

Naz Dar Co.
1087 No. Branch St.
Chicago, IL 60622

APPENDIX G

SAMPLING PROCEDURES

SAMPLING PROCEDURES

Following the selection of sampling sites, final preparations were made for the field activities. The sampling protocol developed by EPA (Draft EPA Sampling Protocol for Measurement of Toxics, October 1976) was used as a basis for sample collection. However, due to the nature of wastewater treatment at the sites selected, some modifications to the EPA protocol were required. These modifications, which were approved by the Project Officer, are described below. Additionally, all samples analyzed for toxic substances were run in accordance with EPA Draft Analytical Protocol for the Measurement of Toxic Substances, October 1976.

Protocol Modifications

The protocol developed for priority pollutant sampling recommends the collection of composite samples. Since, at three of the six plants visited, ink process wastewater is collected over a period of time in holding tanks, the recommended composite sampling method was not necessary. At the remaining three plants, composite samples were taken at the discharge from hot caustic tub washers on the days that they were operating.

Besides the collection of grab samples, some modifications of the protocol's sample preservation methods were required. In order to correlate the data between this sampling program and the one conducted during the 1976 study, the preservation method recommended in the protocol for the phenol fraction was changed. The protocol shows phosphoric or sulfuric acid alone being used for phenol sample preservation. For the 1976 study, samples were preserved in accordance with the guidelines established under section 304g of the Act (Methods for Chemical Analysis of Water and Wastes, U.S. EPA, Monitoring and Support Laboratory, 1974). Specifically, the phenol fractions were preserved with copper sulfate plus phosphoric acid. To maintain uniformity, copper sulfate and phosphoric acid were also used to preserve phenol samples collected during the 1977 sampling program.

An additional variation related to the protocol required precautions against the presence of residual chlorine in samples. Sample fractions collected during the 1977 sampling program were not checked for residual chlorine in the field. This procedure was deemed unnecessary because all of the plants sampled discharge to publicly owned treatment works precluding the need for effluent chlorination. This fact was verified in the field by the sampling teams.

Sample Collection

Table G-1 summarizes the number of samples taken at each site during the 1977/78 sampling program. The four possible sampling points at each plant were as follows:

(1) Intake Water or plant water supply - These samples were collected and analyzed to obtain background measurements.

(2) Untreated Wastewater - Tub and equipment cleanings. Composite samples were taken of the water rinse discharge from hot caustic washers at three of the plants. At the other three plants the untreated wastewater was collected in holding tanks prior to outside disposal or discharge to the sewer. At these plants, grab samples were taken from the tanks after the wastewater was mixed to ensure a representative sample for the collection period. The length of collection period ranged from a few hours to over two weeks, depending upon each plant's production schedule.

(3) Treated Wastewater - At five of the six plants the untreated wastewater was combined with other plant waste streams (e.g., cooling water, boiler blowdown) before treatment or disposal. Consequently, no treated wastewater samples were taken at these plants. At the remaining plant, a composite sample was taken before the treated wastewater was discharged to the sewer.

(4) Sampler Blanks - Deionized water was run through the automatic samplers prior to taking composite samples. This was done to ascertain the amount of hydrocarbon contamination introduced by the sampler tubing.

At two of the six plants, more than one untreated sample was taken to account for possible variability in wastewater composition. After the samples were taken, they were properly labeled, packed in ice, and shipped to the appropriate laboratories for analyses. In most instances, the samples were shipped by air freight and received at the labs within 24 hours after sampling. A chain of custody forms, signed by the samplers, accompanied each set of samples back to the labs.

Inventory of Sampling Points

Table G-2 presents pertinent information regarding each sample taken during the 1977/78 study.

TABLE G-1

NUMBER OF SAMPLES FROM EACH INK PLANT

Plant	Type of Treatment	Type of Sample	Intake	Untreated	Treated	Sampler Blank
7	A	Grab	1	2		
10	B	Composite	1	3		1
19	A	Composite	1	1		1
21	A	Grab	1	1		
22	B,C,D	Composite	2	2	2	2
23	B,C	Grab	1	1	—	—
Total			7	10	2	4

Type of Treatment

A - None
B - Gravity Separation
C - Settling and Clarification
D - Neutralization

TABLE G-2

1977-1978 Inventory of Sample Points
Paint/Ink Industry

Part A: Burns and Roe/Richardson Associates Sampling Program

B&R Code	EMRA Code	Sampling Date	Airbill to Carborundum	Personnel Present B&R	Personnel Present EMRA	Ship Date/AB# to Richardson	Data Rec'd Date	Remarks
1-1-R	5-A-002	9/14/77	EWR 1321297	P.S.,M.S.	T.D.,A.C.	Hand Carried	Note: All Classical Data Rec'd by 2/24/78 All Priority Pollutant and Metals Data Received by 11/1/78	B&R Code not assigned to fraction bottles
1-1-I	5-A-001	9/14/77	"	P.S.,M.S.	T.D.,A.C.	"		
1-1-T	5-H-016	9/27/77	PHL 4074075	E.C.	E.E.	Hand Carried		Tank clogged-treated water in tank 2 wks.
1-2-R	5-L-001	10/25/77		M.S.	L.W.	Hand Carried		
1-2-T	5-L-002	10/26/77		M.S.	L.W.	Hand Carried		
1-3-R	5-L-004	11/3/77		M.S.	L.W.	Hand Carried		
1-3-T	5-H-008	11/7/77		P.S.	A.C.	Hand Carried		
2-1-R	5-G-016	9/21/77	ORD 4472043	M.S.	B.Z.	ORD 4472044		
2-1-I	5-G-017	9/21/77	ORD 4472043	M.S.	B.Z.	ORD 4472044		
2-1-T	5-G-021	9/22/77	ORD 4486391	M.S.	B.Z.	ORD 88212913		
2-1-S	5-G-022	9/22/77	ORD 4486391	M.S.	B.Z.	ORD 88212913		
2-2-R	5-G-023	9/23/77		M.S.				No treated taken- batch released before sampling
2-3-R	5-F-024	9/26/77		P.S.,M.S.		ORD 89328245		
2-3-T	5-F-025	9/27/77		M.S.		ORD 88213753		
2-3-S	5-F-026	9/27/77		M.S.		ORD 88213753		
2-4-R	5-F-067	11/9/77		M.S.		ORD 89256204		
2-4-T	5-F-068	11/10/77			E.K.	ORD 46765121		
2-4-S	5-F-069	11/10/77			E.K.	ORD 46765121		
3-1-R	5-F-001	9/19/77		P.S.,M.S.	E.K.,B.Z.			
3-1-T	5-F-002	9/19/77		P.S.,M.S.	E.K.,B.Z.			
3-1-I	5-F-003	9/19/77		P.S.,M.S.	E.K.,B.Z.			
3-1-S	5-F-004	9/19/77		P.S.,M.S.	E.K.,B.Z.			
3-2-R	5-G-018	9/21/77		M.S.	B.Z.	ORD 4472044		
3-2-T	5-G-019	9/21/77		M.S.	B.Z.	ORD 4472044		
3-2-S	5-G-020	9/21/77		M.S.	B.Z.	ORD 4472044		
3-3-R	5-F-027	9/27/77		M.S.		ORD 88213753		
3-3-T	5-F-028	9/27/77		M.S.		ORD 88213753		
3-3-S	5-F-029	9/27/77		M.S.		ORD 88213753		
4-1-R	5-F-005	9/20/77		P.S.,M.S.	E.K.,B.Z.			
4-1-I	5-F-006	9/20/77		P.S.,M.S.	E.K.,B.Z.			
4-1-T	5-G-008	9/21/77	ORD 4472043	P.S.,M.S.	B.Z.	ORD 4472044		
4-1-S	5-G-007	9/21/77		P.S.,M.S.	B.Z.	ORD 4472044		
4-2-R	5-F-030	9/27/77		M.S.		ORD 88213753		
4-2-T	5-F-031	9/28/77		M.S.		ORD 89328282		
4-2-S	5-F-032	9/28/77		M.S.		ORD 89328282		
4-3-R	5-F-036	9/28/77		M.S.	E.K.	ORD 88213915		
4-3-T	5-F-037	9/29/77		M.S.	E.K.	ORD 48304255		
4-3-S	5-F-038	9/20/77		M.S.	E.K.	ORD 48304255		
5-1-R	5-F-009	9/21/77	MKE 2647099		E.K.	MKE 2647098		
5-1-I	5-F-010	9/21/77	MKE 2647099		E.K.	MKE 2647098		
5-1-T	5-F-011	9/22/77	MKE 2650103		E.K.	MKE 41466972		
5-1-S	5-F-012	9/22/77			E.K.	MKE 41466972		
5-2-R	5-F-013	9/22/77			E.K.	MKE 2650103		Treatment didn't work, released as sludge
5-3-R	5-F-033	9/27/77			E.K.	MKE 45183526		
5-3-T	5-F-034	9/28/77		P.S.	E.K.	MKE 45163366		
5-3-S	5-F-035	9/28/77		P.S.	E.K.	MKE 45163366		
5-3-R*	5-F-060	11/8/77		M.S.,T.F.	E.K.	MKE 48913410		*Fractions should be assigned 5-4-R,T,S, not 5-3-R,T,S
5-3-T*	5-F-063	11/9/77		T.F.	E.K.	ORD 89256204		
5-3-S*	5-F-064	11/9/77		T.F.	E.K.	ORD 89256204		
6-1-R	5-G-040	9/27/77	ORD 4474418	P.S.	B.Z.	ORD 88213720		
6-1-I	5-G-039	9/27/77	ORD 4474418	P.S.	B.Z.	ORD 88213720		
6-1-T	5-G-041	9/27/77	ORD 4474418	P.S.	B.Z.	ORD 88213720		
6-1-S	5-G-042	9/27/77		P.S.	B.Z.	ORD 88213720		
6-2-R	5-G-043	9/28/77		P.S.	B.Z.	ORD 88213915		
6-2-T	5-G-044	9/29/77		P.S.	B.Z.	ORD 48304255		Treatment done twice
6-2-S	5-G-045	9/29/77		P.S.	B.Z.	ORD 48304255		
6-3-R	5-G-046	9/29/77		P.S.	B.Z.	ORD 48304255		
6-3-T	5-G-047	9/29/77			B.Z.,E.K.	ORD 48304255		
6-3-S	5-G-048	9/29/77			B.Z.,E.K.	ORD 48304255		
7-1-R	5-G-049	9/29/77		P.S.,M.S.		MKE 88856011		
7-2-R	5-F-061	11/8/77	MKE 2661714	T.F.,M.S.	E.K.	MKE 48913410		Tot.metal not processed-taken from extra sample fraction
7-2-I	5-F-062	11/9/77	MKE 2661714	T.F.,M.S.	E.K.	MKE 48913410		
8-1-R	5-C-037	10/11/77		P.S.,M.S.	G.A.,A.C.	LAX 43290730		
8-1-T	5-C-038	10/11/77		P.S.,M.S.	G.A.,A.C.	LAX 43290730		
8-1-S	5-C-039	10/11/77		P.S.,M.S.	G.A.,A.C.	LAX 43290730		
8-2-R	5-H-003	10/13/77	LAX 3960383	P.S.	A.C.	LAX 43291614		
8-2-I	5-H-004	10/13/77	LAX 3960383	P.S.	A.C.	LAX 43291614		
8-2-T	5-H-006	10/13/77	LAX 3960383	P.S.,M.S.	G.A.,A.C.	LAX 43291614		
8-2-S	5-H-005	10/13/77		P.S.,M.S.	G.A.,A.C.	LAX 43291614		
8-3-R	5-C-049	10/18/77		M.S.	A.C.	LAX 43291625		
8-3-T	5-C-050	10/18/77		M.S.	A.C.,G.A.	LAX 43291625		
8-3-S	5-C-051	10/18/77		M.S.	A.C.,G.A.	LAX 43291625		
9-1-R	5-C-042	10/12/77		P.S.,M.S.		LAX 43291010		
9-1-T	5-C-043	10/13/77		M.S.	G.A.	LAX 43291614		
9-1-S	5-C-044	10/13/77		M.S.	G.A.	LAX 43291614		
9-1-I	5-C-045	10/13/77	LAX 3960383	M.S.	G.A.	LAX 43291614		
9-2-R	5-C-046	10/13/77	LAX 3960383	P.S.,M.S.	G.A.,A.C.	LAX 43291614		
9-2-T	5-H-007	10/14/77	LAX 3962056	P.S.	A.C.	LAX 43292476		

Part A (Cont.)

B&R Code	ENRA Code	Sampling Date	Airbill to Carborundum	Personnel B&R	Present ENRA	Ship Date/AB# to Richardson	Data Rec'd Date	Remarks
9-2-S	5-W-008	10/14/77		P.S.	A.C.	LAX 43292476		
9-3-R	5-C-048	10/17/77		M.S.	G.A.,A.C.			
9-3-T	5-C-052	10/18/77			G.A.	LAX 43291625		
9-3-S	5-C-053	10/18/77			G.A.	LAX 43291625		
10-1-R	5-C-040	10/12/77	LAX 3960333	P.S.,M.S.	A.C.,G.A.	LAX 43291010		Composite
10-1-I	5-C-041	10/12/77	LAX 3960333	P.S.,M.S.	A.C.,G.A.	LAX 43291010		
10-2-R	5-C-047	10/14/77		M.S.	G.A.	LAX 43292476		Composite
10-3-R	5-C-054	10/20/77		M.S.	G.A.,A.C.			Composite
11-1-R	5-F-065	11/10/77	ORD 4509943	M.S.,T.F.		ORD 46765121		
11-1-I	5-F-066	11/10/77	ORD 4509943	M.S.,T.F.		ORD 46765121		
12-1-R	5-F-070	11/10/77	ORD 4509943	T.F.	E.K.	ORD 46765121		
12-1-I	5-F-071	11/10/77	ORD 4509943	T.F.	E.K.	ORD 46765121		
13-1-R	5-W-010	11/14/77	SEA 5476736	P.S.,M.S.	G.A.,A.C.	SEA 5476738		
13-1-I	5-W-011	11/14/77	SEA 5476736	P.S.,M.S.	G.A.,A.C.	SEA 5476738		
13-1-T	5-W-012	11/15/77	SEA 5476740	P.S.,M.S.	G.A.,A.C.	SEA 62486410		
13-1-S	5-W-013	11/15/77		P.S.,M.S.	G.A.,A.C.	SEA 62486410		
13-2-R	5-C-055	11/17/77		P.S.	G.A.	SEA 35532562		
13-2-T	5-C-056	11/18/77		P.S.	G.A.	SEA 28397276		
13-2-S	5-C-057	11/18/77		P.S.	G.A.	SEA 28397276		
13-3-R	5-C-058	11/21/77		M.S.	G.A.,A.C.	SEA 62486082		
13-3-T	5-C-059	11/22/77		M.S.	G.A.,A.C.	SEA 46286903		
13-3-S	5-C-060	11/22/77		M.S.	G.A.,A.C.	SEA 46286903		
14-1-R	5-W-014	11/15/77	SEA 5476740	P.S.,M.S.	G.A.,A.C.	SEA 62486410		
14-1-I	5-W-015	11/15/77	SEA 5476740	P.S.,M.S.	G.A.,A.C.	SEA 62486410		
14-1-T	5-W-016	11/16/77	SEA 5476741	M.S.	G.A.	SEA 35520612		
14-1-S	5-W-017	11/16/77		M.S.	G.A.	SEA 35520612		
14-2-R	5-W-018	11/15/77		P.S.,M.S.	G.A.,A.C.	SEA 62486410		
14-2-T	5-W-019	11/16/77		M.S.	G.A.	SEA 35502612		
14-2-S	5-W-020	11/16/77		M.S.	G.A.	SEA 35502612		
15-1-I	5-W-021	11/16/77	PDX 5366966		A.C.	PDX 26765185		
15-1-R	5-W-022	11/16/77	PDX 5366966		A.C.	PDX 26765185		Composite
15-1-T	5-W-023	11/16/77	PDX 5366964		A.C.	PDX 26765185		Composite
15-2-R	5-W-024	11/17/77			A.C.	PDX 26896645		Composite
15-2-T	5-W-025	11/17/77			A.C.	PDX 26896645		Composite
15-3-R	5-W-026	11/18/77		M.S.	A.C.	PDX 26896756		Composite
15-3-T	5-W-027	11/18/77		M.S.	A.C.	PDX 26896756		Composite
16-1-R	5-W-028A	11/17/77	PDX 5366997	P.S.,M.S.	G.A.	PDX 26896645		
16-1-I	5-W-029A	11/17/77	PDX 5366997	P.S.,M.S.	G.A.	PDX 26896645		
17-1-R	5-W-028B	11/30/77	JFK 5454956		G.A.,A.C.	EWR 09965244		Composite
17-1-I	5-W-029B	11/30/77	JFK 5454956		G.A.,A.C.	EWR 09965244		
17-1-T	5-W-030	11/30/77	JFK 5454956		G.A.,A.C.	EWR 09965244		Composite
17-2-R	5-W-031	12/1/77			G.A.,A.C.	EWR 09965362		Composite
17-2-T	5-W-032	12/1/77			G.A.,A.C.	EWR 09965362		Composite
17-3-R	5-C-064	12/6/77			G.A.,A.C.	EWR 14921255		Composite
17-3-T	5-C-065	12/6/77			G.A.,A.C.	EWR 14921255		Composite
18-1-R	5-W-033	12/2/77	JFK 5454591	P.S.,M.S.	G.A.,A.C.	Hand Carried		
18-1-I	5-W-034	12/2/77	JFK 5454591	P.S.,M.S.	G.A.,A.C.	Hand Carried		
18-1-T	5-C-063	12/5/77	EWR 6022816	P.S.,M.S.		EWR 09965804		
18-2-R	5-C-073	12/9/77		M.S.	G.A.	Hand Carried		
18-2-T	5-W-037	12/12/77		P.S.,M.S.		EWR 15449210		
18-3-R	5-J-001	12/16/77		M.S.		EWR 15449534		
18-3-T	5-J-002	12/19/77		M.S.				
18-3-S	5-J-003	12/29/77		M.S.				No preservative in Cyanide
19-1-R	5-C-061	12/7/77	EWR 6022839	M.S.	G.A.,A.C.			
19-1-I	5-C-062	12/7/77	EWR 6022839		A.C.			
20-1-R	5-C-066	12/7/77	EWR 6022839	M.S.	G.A.			
20-1-I	5-C-067	12/7/77	EWR 6022839	M.S.	G.A.			
20-1-T	5-C-068	12/8/77	EWR 6022855	M.S.	G.A.,A.C.	EWR 15449022		
20-1-S	5-C-069	12/8/77		M.S.	G.A.,A.C.	EWR 15449022		
20-2-R	5-C-070	12/8/77			G.A.,A.C.	EWR 15449022		
20-2-T	5-C-071	12/9/77		M.S.	G.A.	Hand Carried		
20-2-S	5-C-072	12/9/77		M.S.	G.A.	Hand Carried		
20-3-R	5-W-038	12/12/77		M.S.	A.C.	EWR 15449210		
20-3-T	5-W-039	12/13/77		M.S.	A.C.	Hand Carried		
21-1-R	5-W-035	12/9/77	EWR 6047003	P.S.	A.C.	Hand Carried		
21-1-I	5-W-036	12/9/77	EWR 6047003	P.S.	A.C.	Hand Carried		
22-1-R	5-E-001	1/10/78			A.M.			
22-1-I	5-E-002	1/10/78			A.M.			
22-1-T	5-E-003	1/10/78			A.M.			
23-1-R	5-J-006	1/31/78		M.S.				
23-1-I	5-J-007	1/31/78		M.S.				COD not preserved. No VOA blank sent to Carborundum.

PERSONNEL

Burns and Roe	E.E. Richardson
Henry Celestino	Garret Area
Tom Fieldsend	Angelo Conte
Mark Sadowski	Tom Dean
Paul Storch	Bill Elliott
	Eric Hoffa
	Earl Kunkle
	Albert Merena
	Larry Willey

TABLE F-1

PART B: EPA REGIONAL OFFICES SAMPLING PROGRAM

S&R Code	EGD-SCC* Code	Regional Sample Code	Sample Point	Sampling Date	Personnel Present S&R	Personnel Present Regional, EPA	Data Rec'd Date	Remarks
2	00215	08-05-CM19802	R	10/2/78	MS	EM	The majority	
2	00214	08-05-CM19801	I	10/3/78		EM	of the	
2	00216	08-05-CM19803	T	10/4/78	MS	EM	organic data	
2	00217	08-05-CM19804	S	10/4/78	MS	EM	received by	
3	00129	08-05-CM29802	R	10/3/78	MS,PS	CM	12/18/78	
3	00128	08-05-CM29801	I	10/3/78	MS,PS	EM		
3	00130	08-05-CM29803	T	10/3/78	MS,PS	EM		
3	00131	08-05-CM29804	S	10/3/78	MS,PS	EM		
4	00119	CB30802	R	10/5/78	MS,PS	SB		
4	00118	CB30801	I	10/5/78	MS,PS	SB		
4	00120	CB30803	T	10/6/78	MS	SB		
4	00121	CB30804	S	10/6/78	MS	SB		
5	00062		R	9/19/78	MS	WK		
5	00061		I	9/19/78	MS	WK		
5	00063		T	9/20/78	MS	WK		
5	00064		S	9/20/78	MS	WK		
6	00113	CB01S02	R	10/4/78	MS,PS	SB		
6	00112	CB01S01	I	10/4/78	MS,PS	SB		
6	00114	CB01S03	T	10/4/78	MS,PS	SB		
6	00115	CB01S04	S	10/4/78	MS,PS	SB		
7	00069		R	9/19/78	MS	WK		
7	00067		I	9/19/78	MS	WK		
12	00123	CB31S02	R	10/5/78	MS,PS	SB		
12	00122	CB31S01	I	10/5/78	MS,PS	SB		
12	00124	CB31S03	T	10/6/78	MS	SB		
12	00125	CB31S04	S	10/6/78	MS	SB		
22		08-05-E61502	R	10/11/78	MS	CB		
22		08-05-E619503	I	10/11/78	MS	CB		
22		08-05-E619504	T	10/11/78	MS	CB		
22			S	10/11/78	MS	CB		
24		S01	R	6/26/78	PS	PG		
24		S04	T	6/27/78	PS	PG		
24		S09	I	6/27/78	PS	PG		
24		S02	R	6/27/78	PS	PG		
24		S05	T	6/27/78	PS	PG		
24		S03	R	6/27/78	PS	PG		
24		S06	T	6/27/78	PS	PG		
24		S07	S	6/27/78	PS	PG		- One sludge sample
25		1520	R	7/11/78	MS	GD		represents all 3
25		1521	T	7/11/78	MS	GD		batches of ww.
25		1523	R	7/12/78		GD		
25		1524	T	7/12/78		GD		
25		1525	I	7/12/78		GD		
26		1519	R	7/11/78	MS	KC		
26		1518	I	7/11/78	MS	KC		
26		1544	T	7/14/78		KC		
26		1545	S	7/14/78		KC		
27		0805EG18802	R	8/16/78		JG		
27		0805EG18801	I	8/16/78		JG		
27		0805EG18804	T	8/21/78		JG		- Sample taken of
27		0805EG18803	S	8/18/78		JG		a later batch
27		0805EG18806	L	8/16/78		JG		of ww.
28		PS-1	R	1/25/78	HF	RR		- No treated
28		PS-4	I	1/25/78	HF	RR		sample taken

Sample Points

R - Raw Wastewater
T - Treated Wastewater
S - Sludge
I - Tap Water

EGD-SCC - Effluent Guidelines Division
Sample Control Center

Personnel

Burns and Roe

HF - Howard Feiler
MS - Mark Sadowski
PS - Paul Storch

U.S. EPA Regional S&A

CB - Charles Beiers - Region V
SB - Sylvester Barnotas - Region V
KC - Kenneth Cooper - Region VI
GD - Glen Draper - Region VI
PG - Philip Gehring - Region V
JG - Joseph Good - Region V
WK - Wayne Kaiser - Region V
EM - Everett Mortenson - Region V
RR - Robert Reeves - Region VI

APPENDIX H

ANALYTICAL DATA FROM INDIVIDUAL PLANT SITES

ALL UNITS UG/l UNLESS OTHERWISE NOTED

PLANT	BATCH	PP	------PARAMETER----------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
7	1	114	ANTIMONY	350	NOT RUN		NOT RUN	NOT RUN
7	1	115	ARSENIC	L 25	NOT RUN		NOT RUN	NOT RUN
7	1	117	BERYLLIUM	L 10	NOT RUN		NOT RUN	NOT RUN
7	1	118	CADMIUM	L 20	NOT RUN		NOT RUN	NOT RUN
7	1	119	CHROMIUM	200000	NOT RUN		NOT RUN	NOT RUN
7	1	120	COPPER	400	NOT RUN		NOT RUN	NOT RUN
7	1	121	CYANIDE	130	NOT RUN		NOT RUN	NOT RUN
7	1	122	LEAD	200000	NOT RUN		NOT RUN	NOT RUN
7	1	123	MERCURY	L 5	NOT RUN		NOT RUN	NOT RUN
7	1	124	NICKEL	L 50	NOT RUN		NOT RUN	NOT RUN
7	1	125	SELENIUM	L 25	NOT RUN		NOT RUN	NOT RUN
7	1	126	SILVER	L 10	NOT RUN		NOT RUN	NOT RUN
7	1	127	THALLIUM	L 10	NOT RUN		NOT RUN	NOT RUN
7	1	128	ZINC	3000	NOT RUN		NOT RUN	NOT RUN
7	1		PH(UNITS)	8	NOT RUN		NOT RUN	NOT RUN
7	1		BOD(MG-L)	18000	NOT RUN		NOT RUN	NOT RUN
7	1		COD(MG-L)	27000	NOT RUN		NOT RUN	NOT RUN
7	1		TOC(MG-L)	12000	NOT RUN		NOT RUN	NOT RUN
7	1		OIL & GREASE(MG-L)	1110	NOT RUN		NOT RUN	NOT RUN
7	1		TOTAL PHENOLS	100	NOT RUN		NOT RUN	NOT RUN
7	1		TOTAL SOLIDS(MG-L)	4600	NOT RUN		NOT RUN	NOT RUN
7	1		TOTAL DISS. SOLIDS(MG-L)	3600	NOT RUN		NOT RUN	NOT RUN
7	1		TOTAL SUSP. SOLIDS(MG-L)	1000	NOT RUN		NOT RUN	NOT RUN
7	1		TOTAL VOLATILE SOLIDS(MG-L)	2300	NOT RUN		NOT RUN	NOT RUN
7	1		VOLATILE DISS. SOLIDS(MG-L)	2000	NOT RUN		NOT RUN	NOT RUN
7	1		TOTAL VOL. SUS. SOLIDS(MG-L)	300	NOT RUN		NOT RUN	NOT RUN
7	1		ALUMINUM	30000	NOT RUN		NOT RUN	NOT RUN
7	1		BARIUM	200	NOT RUN		NOT RUN	NOT RUN
7	1		IRON	6000	NOT RUN		NOT RUN	NOT RUN
7	1		MANGANESE	1000	NOT RUN		NOT RUN	NOT RUN
7	1		CALCIUM(MG-L)	L 50	NOT RUN		NOT RUN	NOT RUN
7	1		MAGNESIUM(MG-L)	28	NOT RUN		NOT RUN	NOT RUN
7	1		BORON	600	NOT RUN		NOT RUN	NOT RUN
7	1		COBALT	L 50	NOT RUN		NOT RUN	NOT RUN
7	1		MOLYBDENUM	2000	NOT RUN		NOT RUN	NOT RUN
7	1		TIN	600	NOT RUN		NOT RUN	NOT RUN
7	1		TITANIUM	700	NOT RUN		NOT RUN	NOT RUN
7	1		VANADIUM	L 100	NOT RUN		NOT RUN	NOT RUN
7	1		YTTRIUM	L 200	NOT RUN		NOT RUN	NOT RUN
7	1		SODIUM	L 150	NOT RUN		NOT RUN	NOT RUN

N-D NOT DETECTED; L-LESS THAN; PP- PRIORITY POLLUTANT NUMBER
PRIORITY POLLUTANTS NOT DETECTED IN ANY SAMPLES ARE NOT LISTED. FRACTIONS NOT ANALYZED ARE NOT LISTED.

PLANT	BATCH	PP	------PARAMETER----------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
				ALL UNITS UG/L UNLESS OTHERWISE NOTED				
7	2	4	BENZENE	45	NOT RUN		NOT RUN	18
7	2	6	CARBON TETRACHLORIDE	96	NOT RUN		NOT RUN	N-D
7	2	40	4-CHLOROPHENYL PHENYL ETHER	N-D	NOT RUN		NOT RUN	40
7	2	44	METHYLENE CHLORIDE	N-D	NOT RUN		NOT RUN	144
7	2	48	DICHLOROBROMOMETHANE	N-D	NOT RUN		NOT RUN	15
7	2	55	NAPHTHALENE	23	NOT RUN		NOT RUN	N-D
7	2	66	BIS(2-ETHYLHEXYL) PHTHALATE	510	NOT RUN		NOT RUN	73
7	2	68	DI-N-BUTYL PHTHALATE	260	NOT RUN		NOT RUN	33
7	2	70	DIETHYL PHTHALATE	25	NOT RUN		NOT RUN	N-D
7	2	81	PHENANTHRENE	L 10	NOT RUN		NOT RUN	N-D
7	2	85	TETRACHLOROETHYLENE	2900	NOT RUN		NOT RUN	N-D
7	2	87	TRICHLOROETHYLENE	2300	NOT RUN		NOT RUN	L 10
7	2	114	ANTIMONY	2200	NOT RUN		NOT RUN	L 10
7	2	115	ARSENIC	L 25	NOT RUN		NOT RUN	L 25
7	2	117	BERYLLIUM	L 4	NOT RUN		NOT RUN	L 20
7	2	118	CADMIUM	30	NOT RUN		NOT RUN	8
7	2	119	CHROMIUM	30000	NOT RUN		NOT RUN	30
7	2	120	COPPER	800	NOT RUN		NOT RUN	200
7	2	121	CYANIDE	51	NOT RUN		NOT RUN	L 20
7	2	122	LEAD	40000	NOT RUN		NOT RUN	100
7	2	123	MERCURY	39	NOT RUN		NOT RUN	2
7	2	124	NICKEL	L 20	NOT RUN		NOT RUN	L 10
7	2	125	SELENIUM	L 25	NOT RUN		NOT RUN	L 25
7	2	126	SILVER	L 4	NOT RUN		NOT RUN	L 2
7	2	127	THALLIUM	L 10	NOT RUN		NOT RUN	L 10
7	2	128	ZINC	3000	NOT RUN		NOT RUN	200
7	2		PH(UNITS)	9	NOT RUN		NOT RUN	9
7	2		BOD(MG-L)	37000	NOT RUN		NOT RUN	L 2
7	2		COD(MG-L)	45000	NOT RUN		NOT RUN	L 5
7	2		TOC(MG-L)	10000	NOT RUN		NOT RUN	7
7	2		OIL & GREASE(MG-L)	860	NOT RUN		NOT RUN	L 1
7	2		TOTAL PHENOLS	360	NOT RUN		NOT RUN	L 20
7	2		TOTAL SOLIDS(MG-L)	11840	NOT RUN		NOT RUN	154
7	2		TOTAL DISS. SOLIDS(MG-L)	10530	NOT RUN		NOT RUN	153
7	2		TOTAL SUSP. SOLIDS(MG-L)	1310	NOT RUN		NOT RUN	1
7	2		TOTAL VOLATILE SOLIDS(MG-L)	9760	NOT RUN		NOT RUN	128
7	2		VOLATILE DISS. SOLIDS(MG-L)	9290	NOT RUN		NOT RUN	127
7	2		TOTAL VOL. SUS. SOLIDS(MG-L)	470	NOT RUN		NOT RUN	1
7	2		ALUMINUM	30000	NOT RUN		NOT RUN	200
7	2		BARIUM	30000	NOT RUN		NOT RUN	30
7	2		IRON	10000	NOT RUN		NOT RUN	L 300
7	2		MANGANESE	600	NOT RUN		NOT RUN	50
7	2		CALCIUM(MG-L)	68	NOT RUN		NOT RUN	34
7	2		MAGNESIUM(MG-L)	15	NOT RUN		NOT RUN	11
7	2		BORON	800	NOT RUN		NOT RUN	100
7	2		COBALT	L 20	NOT RUN		NOT RUN	L 10
7	2		MOLYBDENUM	6000	NOT RUN		NOT RUN	L 10
7	2		TIN	200	NOT RUN		NOT RUN	30
7	2		TITANIUM	70	NOT RUN		NOT RUN	L 30
7	2		VANADIUM	L 50	NOT RUN		NOT RUN	L 20
7	2		YTTRIUM	L 60	NOT RUN		NOT RUN	L 30
7	2		SODIUM	74	NOT RUN		NOT RUN	L 30

N-D NOT DETECTED; L-LESS THAN; PP- PRIORITY POLLUTANT NUMBER
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[illegible]	PP	PARAMETER		INFLUENT (UG/L UNLESS	EFFLUENT OTHERWISE	REMOVAL(%) NOTED)	SLUDGE		TAP WATER
	1	ACENAPHTHENE	L	10	NOT RUN		NOT RUN	L	10
3	4	BENZENE	L	10	NOT RUN		NOT RUN	L	10
3	7	CHLOROBENZENE		27	NOT RUN		NOT RUN		N-D
1	8	1,2,4-TRICHLOROBENZENE	L	80	NOT RUN		NOT RUN	L	10
1	10	1,2-DICHLOROETHANE		159	NOT RUN		NOT RUN		N-D
1	11	1,1,1-TRICHLOROETHANE		1000	NOT RUN		NOT RUN	L	10
3	13	1,1-DICHLOROETHANE		33	NOT RUN		NOT RUN		N-D
1	22	PARACHLOROMETA CRESOL	L	10	NOT RUN		NOT RUN		N-D
1	23	CHLOROFORM		19	NOT RUN		NOT RUN	L	10
1	25	1,2-DICHLOROBENZENE	L	10	NOT RUN		NOT RUN		N-D
1	29	1,1-DICHLOROETHYLENE	L	10	NOT RUN		NOT RUN		N-D
1	30	1,2-TRANS-DICHLOROETHYLENE	L	10	NOT RUN		NOT RUN		N-D
1	32	1,2-DICHLOROPROPANE		22	NOT RUN		NOT RUN		N-D
1	34	2,4-DIMETHYLPHENOL	L	10	NOT RUN		NOT RUN		N-D
3	35	2,4-DINITROTOLUENE	L	10	NOT RUN		NOT RUN		N-D
3	36	2,6-DINITROTOLUENE	L	10	NOT RUN		NOT RUN		N-D
1	37	1,2-DIPHENYLHYDRAZINE	L	10	NOT RUN		NOT RUN		N-D
1	38	ETHYLBENZENE		254	NOT RUN		NOT RUN		N-D
1	39	FLUORANTHENE	L	10	NOT RUN		NOT RUN		N-D
1	42	BIS(2-CHLOROISOPROPYL) ETHER	L	10	NOT RUN		NOT RUN		N-D
1	44	METHYLENE CHLORIDE		2900	NOT RUN		NOT RUN		374
1	49	TRICHLOROFLUOROMETHANE	L	10	NOT RUN		NOT RUN	L	10
3	55	NAPHTHALENE	L	10	NOT RUN		NOT RUN		N-D
1	62	N-NITROSODIPHENYLAMINE	L	10	NOT RUN		NOT RUN		N-D
1	65	PHENOL	L	10	NOT RUN		NOT RUN		N-D
1	66	BIS(2-ETHYLHEXYL) PHTHALATE	L	10	NOT RUN		NOT RUN		N-D
1	67	BUTYL BENZYL PHTHALATE		N-D	NOT RUN		NOT RUN	L	10
3	68	DI-N-BUTYL PHTHALATE	L	10	NOT RUN		NOT RUN	L	10
1	70	DIETHYL PHTHALATE		N-D	NOT RUN		NOT RUN	L	10
1	71	DIMETHYL PHTHALATE	L	10	NOT RUN		NOT RUN		N-D
1	78	ANTHRACENE	L	10	NOT RUN		NOT RUN	L	10
1	80	FLUORENE		N-D	NOT RUN		NOT RUN	L	10
1	81	PHENANTHRENE		N-D	NOT RUN		NOT RUN	L	10
1	84	PYRENE	L	10	NOT RUN		NOT RUN		N-D
1	85	TETRACHLOROETHYLENE		3100	NOT RUN		NOT RUN		N-D
1	86	TOLUENE		6000	NOT RUN		NOT RUN	L	10
1	87	TRICHLOROETHYLENE		5000	NOT RUN		NOT RUN	L	10
1	90	DIELDRIN	L	10	NOT RUN		NOT RUN		N-D
3	114	ANTIMONY	L	2000	NOT RUN		NOT RUN	L	2
3	115	ARSENIC	L	2000	NOT RUN		NOT RUN	L	2
3	117	BERYLLIUM	L	1	NOT RUN		NOT RUN	L	1
1	118	CADMIUM		19	NOT RUN		NOT RUN	L	2
3	119	CHROMIUM		3690	NOT RUN		NOT RUN		13
3	120	COPPER		3120	NOT RUN		NOT RUN		14
1	121	CYANIDE	L	1	NOT RUN		NOT RUN	L	0
3	122	LEAD		14100	NOT RUN		NOT RUN		42
1	123	MERCURY	L	1	NOT RUN		NOT RUN	L	1
1	124	NICKEL		65	NOT RUN		NOT RUN		17
3	125	SELENIUM	L	2000	NOT RUN		NOT RUN	L	2
1	126	SILVER		4	NOT RUN		NOT RUN		5
1	127	THALLIUM	L	2000	NOT RUN		NOT RUN	L	2
1	128	ZINC		2550	NOT RUN		NOT RUN		250
1		FLUORIDES		6	NOT RUN		NOT RUN		8
1		BOD(MG/L)		9900	NOT RUN		NOT RUN	L	2
1		COD(MG/L)		17700	NOT RUN		NOT RUN	L	3
1		TOC(MG/L)		5572	NOT RUN		NOT RUN		2
1		OIL & GREASE(MG/L)		69	NOT RUN		NOT RUN	L	5
1		TOTAL PHENOLS		91	NOT RUN		NOT RUN		18
1		TOTAL SOLIDS(MG/L)		4500	NOT RUN		NOT RUN		159
1		TOTAL SUSP. SOLIDS(MG/L)		2100	NOT RUN		NOT RUN		NOT RUN
1		ALUMINUM		4370	NOT RUN		NOT RUN		81
1		BARIUM		5570	NOT RUN		NOT RUN		8
1		IRON		16100	NOT RUN		NOT RUN	L	170
		MANGANESE		1530	NOT RUN		NOT RUN	L	5
1		CALCIUM(MG/L)		133	NOT RUN		NOT RUN		36
1		MAGNESIUM(MG/L)		15	NOT RUN		NOT RUN		11
1		BORON		333	NOT RUN		NOT RUN		56
1		COBALT	L	5	NOT RUN		NOT RUN	L	5
1		MOLYBDENUM		1020	NOT RUN		NOT RUN		8
1		TIN		81	NOT RUN		NOT RUN		28
1		TITANIUM		229	NOT RUN		NOT RUN	L	15
1		VANADIUM	L	12	NOT RUN		NOT RUN	L	12
1		YTTRIUM	L	16	NOT RUN		NOT RUN	L	16
1		SODIUM		5505	NOT RUN		NOT RUN	L	15

N-D - NOT DETECTED L - LESS THAN PP - PRIORITY POLLUTANT NUMBER
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PLANT	BATCH	PP	------PARAMETER----------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
				ALL UNITS UG/L UNLESS OTHERWISE NOTED				
10	1	4	BENZENE	302	NOT RUN		NOT RUN	40
10	1	14	1,1,2-TRICHLOROETHANE	L 10	NOT RUN		NOT RUN	N-D
10	1	23	CHLOROFORM	110	NOT RUN		NOT RUN	350
10	1	29	1,1-DICHLOROETHYLENE	25	NOT RUN		NOT RUN	N-D
10	1	44	METHYLENE CHLORIDE	1600	NOT RUN		NOT RUN	40
10	1	48	DICHLOROBROMOMETHANE	N-D	NOT RUN		NOT RUN	87
10	1	51	CHLORODIBROMOMETHANE	N-D	NOT RUN		NOT RUN	74
10	1	64	PENTACHLOROPHENOL	1300	NOT RUN		NOT RUN	N-D
10	1	65	PHENOL	41	NOT RUN		NOT RUN	N-D
10	1	68	DI-N-BUTYL PHTHALATE	72	NOT RUN		NOT RUN	N-D
10	1	74	3,4-BENZOFLUORANTHENE	N-D	NOT RUN		NOT RUN	L 10
10	1	86	TOLUENE	10	NOT RUN		NOT RUN	N-D
10	1	114	ANTIMONY	L 25	NOT RUN		NOT RUN	L 100
10	1	115	ARSENIC	L 25	NOT RUN		NOT RUN	L 25
10	1	117	BERYLLIUM	L 10	NOT RUN		NOT RUN	L 10
10	1	118	CADMIUM	L 20	NOT RUN		NOT RUN	L 20
10	1	119	CHROMIUM	20000	NOT RUN		NOT RUN	70
10	1	120	COPPER	900	NOT RUN		NOT RUN	80
10	1	121	CYANIDE	180	NOT RUN		NOT RUN	L 20
10	1	122	LEAD	50000	NOT RUN		NOT RUN	400
10	1	123	MERCURY	11	NOT RUN		NOT RUN	6
10	1	124	NICKEL	L 50	NOT RUN		NOT RUN	L 50
10	1	125	SELENIUM	L 25	NOT RUN		NOT RUN	L 25
10	1	126	SILVER	L 10	NOT RUN		NOT RUN	L 10
10	1	127	THALLIUM	L 10	NOT RUN		NOT RUN	L 10
10	1	128	ZINC	L 600	NOT RUN		NOT RUN	L 600
10	1		PH(UNITS)	8	NOT RUN		NOT RUN	8
10	1		BOD(MG-L)	320	NOT RUN		NOT RUN	L 2
10	1		COD(MG-L)	370	NOT RUN		NOT RUN	16
10	1		TOC(MG-L)	520	NOT RUN		NOT RUN	13
10	1		OIL & GREASE(MG-L)	36	NOT RUN		NOT RUN	L 1
10	1		TOTAL PHENOLS	28	NOT RUN		NOT RUN	8
10	1		TOTAL SOLIDS(MG-L)	3900	NOT RUN		NOT RUN	710
10	1		TOTAL DISS. SOLIDS(MG-L)	3420	NOT RUN		NOT RUN	709
10	1		TOTAL SUSP. SOLIDS(MG-L)	480	NOT RUN		NOT RUN	1
10	1		SETTLEABLE SOLIDS(ML-L)	L 0	NOT RUN		NOT RUN	L 0
10	1		TOTAL VOLATILE SOLIDS(MG-L)	720	NOT RUN		NOT RUN	98
10	1		VOLATILE DISS. SOLIDS(MG-L)	510	NOT RUN		NOT RUN	97
10	1		TOTAL VOL. SUS. SOLIDS(MG-L)	210	NOT RUN		NOT RUN	1
10	1		ALUMINUM	2000	NOT RUN		NOT RUN	L 500
10	1		BARIUM	900	NOT RUN		NOT RUN	70
10	1		IRON	3000	NOT RUN		NOT RUN	L 2000
10	1		MANGANESE	60	NOT RUN		NOT RUN	L 50
10	1		CALCIUM(MG-L)	L 50	NOT RUN		NOT RUN	L 50
10	1		MAGNESIUM(MG-L)	21	NOT RUN		NOT RUN	29
10	1		BORON	L 500	NOT RUN		NOT RUN	L 500
10	1		COBALT	L 50	NOT RUN		NOT RUN	L 50
10	1		MOLYBDENUM	1000	NOT RUN		NOT RUN	100
10	1		TIN	300	NOT RUN		NOT RUN	300
10	1		TITANIUM	300	NOT RUN		NOT RUN	L 200
10	1		VANADIUM	L 100	NOT RUN		NOT RUN	L 100
10	1		YTTRIUM	L 200	NOT RUN		NOT RUN	L 200
10	1		SODIUM	780	NOT RUN		NOT RUN	L 150

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PLANT	BATCH	PP	------PARAMETER----------		INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
					ALL UNITS UG/L UNLESS OTHERWISE NOTED				
10	2	114	ANTIMONY	L	25	NOT RUN		NOT RUN	NOT RUN
10	2	115	ARSENIC	L	25	NOT RUN		NOT RUN	NOT RUN
10	2	117	BERYLLIUM	L	10	NOT RUN		NOT RUN	NOT RUN
10	2	118	CADMIUM	L	20	NOT RUN		NOT RUN	NOT RUN
10	2	119	CHROMIUM		4000	NOT RUN		NOT RUN	NOT RUN
10	2	120	COPPER		300	NOT RUN		NOT RUN	NOT RUN
10	2	121	CYANIDE	L	20	NOT RUN		NOT RUN	NOT RUN
10	2	122	LEAD		10000	NOT RUN		NOT RUN	NOT RUN
10	2	123	MERCURY	L	20	NOT RUN		NOT RUN	NOT RUN
10	2	124	NICKEL	L	50	NOT RUN		NOT RUN	NOT RUN
10	2	125	SELENIUM	L	25	NOT RUN		NOT RUN	NOT RUN
10	2	126	SILVER	L	10	NOT RUN		NOT RUN	NOT RUN
10	2	127	THALLIUM	L	10	NOT RUN		NOT RUN	NOT RUN
10	2	128	ZINC	L	600	NOT RUN		NOT RUN	NOT RUN
10	2		BOD(MG-L)		810	NOT RUN		NOT RUN	NOT RUN
10	2		COD(MG-L)		2200	NOT RUN		NOT RUN	NOT RUN
10	2		TOC(MG-L)		100	NOT RUN		NOT RUN	NOT RUN
10	2		OIL & GREASE(MG-L)		33	NOT RUN		NOT RUN	NOT RUN
10	2		TOTAL PHENOLS		92	NOT RUN		NOT RUN	NOT RUN
10	2		TOTAL SOLIDS(MG-L)		1600	NOT RUN		NOT RUN	NOT RUN
10	2		TOTAL DISS. SOLIDS(MG-L)		1360	NOT RUN		NOT RUN	NOT RUN
10	2		TOTAL SUSP. SOLIDS(MG-L)		240	NOT RUN		NOT RUN	NOT RUN
10	2		SETTLEABLE SOLIDS(ML-L)		0	NOT RUN		NOT RUN	NOT RUN
10	2		TOTAL VOLATILE SOLIDS(MG-L)		300	NOT RUN		NOT RUN	NOT RUN
10	2		VOLATILE DISS. SOLIDS(MG-L)		190	NOT RUN		NOT RUN	NOT RUN
10	2		TOTAL VOL. SUS. SOLIDS(MG-L)		110	NOT RUN		NOT RUN	NOT RUN
10	2		ALUMINUM	L	500	NOT RUN		NOT RUN	NOT RUN
10	2		BARIUM		400	NOT RUN		NOT RUN	NOT RUN
10	2		IRON	L	2000	NOT RUN		NOT RUN	NOT RUN
10	2		MANGANESE	L	50	NOT RUN		NOT RUN	NOT RUN
10	2		CALCIUM(MG-L)	L	50	NOT RUN		NOT RUN	NOT RUN
10	2		MAGNESIUM(MG-L)		21	NOT RUN		NOT RUN	NOT RUN
10	2		BORON	L	500	NOT RUN		NOT RUN	NOT RUN
10	2		COBALT	L	50	NOT RUN		NOT RUN	NOT RUN
10	2		MOLYBDENUM		400	NOT RUN		NOT RUN	NOT RUN
10	2		TIN		300	NOT RUN		NOT RUN	NOT RUN
10	2		TITANIUM	L	200	NOT RUN		NOT RUN	NOT RUN
10	2		VANADIUM	L	100	NOT RUN		NOT RUN	NOT RUN
10	2		YTTRIUM	L	200	NOT RUN		NOT RUN	NOT RUN
10	2		SODIUM		480	NOT RUN		NOT RUN	NOT RUN

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ALL UNITS UG/L UNLESS OTHERWISE NOTED

PLANT	BATCH	PP	------PARAMETER----------		INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
10	3	114	ANTIMONY	L	25	NOT RUN		NOT RUN	NOT RUN
10	3	115	ARSENIC	L	25	NOT RUN		NOT RUN	NOT RUN
10	3	117	BERYLLIUM	L	10	NOT RUN		NOT RUN	NOT RUN
10	3	118	CADMIUM	L	20	NOT RUN		NOT RUN	NOT RUN
10	3	119	CHROMIUM		2000	NOT RUN		NOT RUN	NOT RUN
10	3	120	COPPER		100	NOT RUN		NOT RUN	NOT RUN
10	3	121	CYANIDE	L	80	NOT RUN		NOT RUN	NOT RUN
10	3	122	LEAD		3000	NOT RUN		NOT RUN	NOT RUN
10	3	123	MERCURY	L	1	NOT RUN		NOT RUN	NOT RUN
10	3	124	NICKEL	L	50	NOT RUN		NOT RUN	NOT RUN
10	3	125	SELENIUM	L	25	NOT RUN		NOT RUN	NOT RUN
10	3	126	SILVER	L	10	NOT RUN		NOT RUN	NOT RUN
10	3	127	THALLIUM	L	10	NOT RUN		NOT RUN	NOT RUN
10	3	128	ZINC	L	600	NOT RUN		NOT RUN	NOT RUN
10	3		PH(UNITS)		9	NOT RUN		NOT RUN	NOT RUN
10	3		BOD(MG-L)		75	NOT RUN		NOT RUN	NOT RUN
10	3		COD(MG-L)		730	NOT RUN		NOT RUN	NOT RUN
10	3		TOC(MG-L)		70	NOT RUN		NOT RUN	NOT RUN
10	3		OIL & GREASE(MG-L)		160	NOT RUN		NOT RUN	NOT RUN
10	3		TOTAL PHENOLS		96	NOT RUN		NOT RUN	NOT RUN
10	3		TOTAL SOLIDS(MG-L)		1100	NOT RUN		NOT RUN	NOT RUN
10	3		TOTAL DISS. SOLIDS(MG-L)		1007	NOT RUN		NOT RUN	NOT RUN
10	3		TOTAL SUSP. SOLIDS(MG-L)		93	NOT RUN		NOT RUN	NOT RUN
10	3		SETTLEABLE SOLIDS(ML-L)		0	NOT RUN		NOT RUN	NOT RUN
10	3		TOTAL VOLATILE SOLIDS(MG-L)		190	NOT RUN		NOT RUN	NOT RUN
10	3		VOLATILE DISS. SOLIDS(MG-L)		137	NOT RUN		NOT RUN	NOT RUN
10	3		TOTAL VOL. SUS. SOLIDS(MG-L)		53	NOT RUN		NOT RUN	NOT RUN
10	3		ALUMINUM	L	500	NOT RUN		NOT RUN	NOT RUN
10	3		BARIUM		200	NOT RUN		NOT RUN	NOT RUN
10	3		IRON	L	2000	NOT RUN		NOT RUN	NOT RUN
10	3		MANGANESE	L	50	NOT RUN		NOT RUN	NOT RUN
10	3		CALCIUM(MG-L)	L	50	NOT RUN		NOT RUN	NOT RUN
10	3		MAGNESIUM(MG-L)	L	27	NOT RUN		NOT RUN	NOT RUN
10	3		BORON	L	500	NOT RUN		NOT RUN	NOT RUN
10	3		COBALT	L	50	NOT RUN		NOT RUN	NOT RUN
10	3		MOLYBDENUM		70	NOT RUN		NOT RUN	NOT RUN
10	3		TIN	L	50	NOT RUN		NOT RUN	NOT RUN
10	3		TITANIUM	L	200	NOT RUN		NOT RUN	NOT RUN
10	3		VANADIUM	L	100	NOT RUN		NOT RUN	NOT RUN
10	3		YTTRIUM	L	200	NOT RUN		NOT RUN	NOT RUN
10	3		SODIUM		240	NOT RUN		NOT RUN	NOT RUN

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PLANT	BATCH	PP	------PARAMETER----------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
				ALL UNITS UG/L UNLESS OTHERWISE NOTED				
19	1	4	BENZENE	1600	NOT RUN		NOT RUN	135
19	1	15	1,1,2,2-TETRACHLOROETHANE	N-D	NOT RUN		NOT RUN	L 10
19	1	38	ETHYLBENZENE	5500	NOT RUN		NOT RUN	N-D
19	1	44	METHYLENE CHLORIDE	N-D	NOT RUN		NOT RUN	408
19	1	65	PHENOL	536	NOT RUN		NOT RUN	N-D
19	1	66	BIS(2-ETHYLHEXYL) PHTHALATE	95	NOT RUN		NOT RUN	N-D
19	1	69	DI-N-OCTYL PHTHALATE	3600	NOT RUN		NOT RUN	N-D
19	1	78	ANTHRACENE	16	NOT RUN		NOT RUN	N-D
19	1	85	TETRACHLOROETHYLENE	61	NOT RUN		NOT RUN	N-D
19	1	86	TOLUENE	950	NOT RUN		NOT RUN	N-D
19	1	87	TRICHLOROETHYLENE	45	NOT RUN		NOT RUN	N-D
19	1	114	ANTIMONY	L 25	NOT RUN		NOT RUN	32
19	1	115	ARSENIC	L 25	NOT RUN		NOT RUN	L 25
19	1	117	BERYLLIUM	L 10	NOT RUN		NOT RUN	L 1
19	1	118	CADMIUM	L 20	NOT RUN		NOT RUN	L 2
19	1	119	CHROMIUM	20000	NOT RUN		NOT RUN	10
19	1	120	COPPER	10000	NOT RUN		NOT RUN	10
19	1	121	CYANIDE	260	NOT RUN		NOT RUN	L 20
19	1	122	LEAD	900000	NOT RUN		NOT RUN	40
19	1	123	MERCURY	L 5	NOT RUN		NOT RUN	L 1
19	1	124	NICKEL	L 50	NOT RUN		NOT RUN	L 5
19	1	125	SELENIUM	L 25	NOT RUN		NOT RUN	L 25
19	1	126	SILVER	L 10	NOT RUN		NOT RUN	L 1
19	1	127	THALLIUM	L 10	NOT RUN		NOT RUN	L 10
19	1	128	ZINC	20000	NOT RUN		NOT RUN	L 60
19	1		PH(UNITS)	13	NOT RUN		NOT RUN	6
19	1		BOD(MG-L)	890	NOT RUN		NOT RUN	L 2
19	1		COD(MG-L)	3000	NOT RUN		NOT RUN	2
19	1		TOC(MG-L)	440	NOT RUN		NOT RUN	4
19	1		OIL $ GREASE(MG-L)	55	NOT RUN		NOT RUN	2
19	1		TOTAL PHENOLS	700	NOT RUN		NOT RUN	L 20
19	1		TOTAL SOLIDS(MG-L)	11000	NOT RUN		NOT RUN	2305
19	1		TOTAL DISS. SOLIDS(MG-L)	8300	NOT RUN		NOT RUN	2299
19	1		TOTAL SUSP. SOLIDS(MG-L)	2700	NOT RUN		NOT RUN	6
19	1		TOTAL VOLATILE SOLIDS(MG-L)	720	NOT RUN		NOT RUN	150
19	1		VOLATILE DISS. SOLIDS(MG-L)	350	NOT RUN		NOT RUN	145
19	1		TOTAL VOL. SUS. SOLIDS(MG-L)	370	NOT RUN		NOT RUN	5
19	1		ALUMINUM	300000	NOT RUN		NOT RUN	L 50
19	1		BARIUM	20000	NOT RUN		NOT RUN	L 5
19	1		IRON	50000	NOT RUN		NOT RUN	L 200
19	1		MANGANESE	500	NOT RUN		NOT RUN	L 5
19	1		CALCIUM(MG-L)	10000	NOT RUN		NOT RUN	420
19	1		MAGNESIUM(MG-L)	870	NOT RUN		NOT RUN	38
19	1		BORON	L 500	NOT RUN		NOT RUN	400
19	1		COBALT	L 50	NOT RUN		NOT RUN	L 5
19	1		MOLYBDENUM	1000	NOT RUN		NOT RUN	20
19	1		TIN	600	NOT RUN		NOT RUN	40
19	1		TITANIUM	3000	NOT RUN		NOT RUN	L 20
19	1		VANADIUM	100	NOT RUN		NOT RUN	20
19	1		YTTRIUM	L 200	NOT RUN		NOT RUN	L 20
19	1		SODIUM	12200	NOT RUN		NOT RUN	82

N-D NOT DETECTED; L-LESS THAN; PP- PRIORITY POLLUTANT NUMBER
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PLANT	BATCH	PP	------PARAMETER----------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
				ALL UNITS UG/L UNLESS OTHERWISE NOTED				
21	1	4	BENZENE	33	NOT RUN		NOT RUN	47
21	1	11	1,1,1-TRICHLOROETHANE	120	NOT RUN		NOT RUN	N-D
21	1	13	1,1-DICHLOROETHANE	10	NOT RUN		NOT RUN	N-D
21	1	23	CHLOROFORM	N-D	NOT RUN		NOT RUN	170
21	1	29	1,1-DICHLOROETHYLENE	L 10	NOT RUN		NOT RUN	N-D
21	1	44	METHYLENE CHLORIDE	26	NOT RUN		NOT RUN	N-D
21	1	48	DICHLOROBROMOMETHANE	N-D	NOT RUN		NOT RUN	23
21	1	66	BIS(2-ETHYLHEXYL) PHTHALATE	87000	NOT RUN		NOT RUN	N-D
21	1	68	DI-N-BUTYL PHTHALATE	770	NOT RUN		NOT RUN	N-D
21	1	85	TETRACHLOROETHYLENE	170	NOT RUN		NOT RUN	N-D
21	1	86	TOLUENE	580	NOT RUN		NOT RUN	N-D
21	1	87	TRICHLOROETHYLENE	19	NOT RUN		NOT RUN	N-D
21	1	114	ANTIMONY	50	NOT RUN		NOT RUN	L 10
21	1	115	ARSENIC	L 25	NOT RUN		NOT RUN	L 25
21	1	117	BERYLLIUM	L 10	NOT RUN		NOT RUN	L 10
21	1	118	CADMIUM	80	NOT RUN		NOT RUN	L 20
21	1	119	CHROMIUM	60000	NOT RUN		NOT RUN	100
21	1	120	COPPER	100000	NOT RUN		NOT RUN	80
21	1	121	CYANIDE	540	NOT RUN		NOT RUN	L 20
21	1	122	LEAD	200000	NOT RUN		NOT RUN	L 200
21	1	123	MERCURY	1100	NOT RUN		NOT RUN	L 1
21	1	124	NICKEL	L 50	NOT RUN		NOT RUN	L 50
21	1	125	SELENIUM	L 25	NOT RUN		NOT RUN	L 25
21	1	126	SILVER	L 10	NOT RUN		NOT RUN	L 10
21	1	127	THALLIUM	L 10	NOT RUN		NOT RUN	L 10
21	1	128	ZINC	10000	NOT RUN		NOT RUN	L 600
21	1		PH(UNITS)	10	NOT RUN		NOT RUN	6
21	1		BOD(MG-L)	110000	NOT RUN		NOT RUN	L 2
21	1		COD(MG-L)	270000	NOT RUN		NOT RUN	6
21	1		TOC(MG-L)	66000	NOT RUN		NOT RUN	6
21	1		OIL & GREASE(MG-L)	1500	NOT RUN		NOT RUN	1
21	1		TOTAL PHENOLS	510	NOT RUN		NOT RUN	L 20
21	1		TOTAL SOLIDS(MG-L)	51275	NOT RUN		NOT RUN	198
21	1		TOTAL DISS. SOLIDS(MG-L)	51000	NOT RUN		NOT RUN	194
21	1		TOTAL SUSP. SOLIDS(MG-L)	275	NOT RUN		NOT RUN	4
21	1		TOTAL VOLATILE SOLIDS(MG-L)	77500	NOT RUN		NOT RUN	92
21	1		VOLATILE DISS. SOLIDS(MG-L)	77285	NOT RUN		NOT RUN	88
21	1		TOTAL VOL. SUS. SOLIDS(MG-L)	215	NOT RUN		NOT RUN	4
21	1		ALUMINUM	30000	NOT RUN		NOT RUN	L 500
21	1		BARIUM	20000	NOT RUN		NOT RUN	L 50
21	1		IRON	10000	NOT RUN		NOT RUN	L 2000
21	1		MANGANESE	80	NOT RUN		NOT RUN	60
21	1		CALCIUM(MG-L)	L 50	NOT RUN		NOT RUN	L 50
21	1		MAGNESIUM(MG-L)	2	NOT RUN		NOT RUN	3
21	1		BORON	1000	NOT RUN		NOT RUN	L 500
21	1		COBALT	L 50	NOT RUN		NOT RUN	L 50
21	1		MOLYBDENUM	600000	NOT RUN		NOT RUN	300
21	1		TIN	1000	NOT RUN		NOT RUN	L 50
21	1		TITANIUM	3000	NOT RUN		NOT RUN	L 200
21	1		VANADIUM	600	NOT RUN		NOT RUN	L 100
21	1		YTTRIUM	L 200	NOT RUN		NOT RUN	L 200
21	1		SODIUM	1100	NOT RUN		NOT RUN	L 150

N-D NOT DETECTED; L-LESS THAN; PP- PRIORITY POLLUTANT NUMBER
PRIORITY POLLUTANTS NOT DETECTED IN ANY SAMPLES ARE NOT LISTED. FRACTIONS NOT ANALYZED ARE NOT LISTED.

PLANT	BATCH	PP	------PARAMETER------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
				ALL UNITS UG/L UNLESS OTHERWISE NOTED				
22	2	1	ACENAPHTHENE	N-D	L 10	0	NOT RUN	N-D
22	2	4	BENZENE	220	96	56	NOT RUN	N-D
22	2	7	CHLOROBENZENE	530	N-D	100	NOT RUN	N-D
22	2	21	2,4,6-TRICHLOROPHENOL	L 10	N-D	100	NOT RUN	N-D
22	2	23	CHLOROFORM	N-D	N-D		NOT RUN	16
22	2	28	3,3'-DICHLOROBENZIDINE	N-D	L 10	0	NOT RUN	N-D
22	2	31	2,4-DICHLOROPHENOL	N-D	L 10	0	NOT RUN	N-D
22	2	33	1,3-DICHLOROPROPYLENE	N-D	N-D		NOT RUN	N-D
22	2	35	2,4-DINITROTOLUENE	N-D	L 10	0	NOT RUN	N-D
22	2	38	ETHYLBENZENE	6700	2400	64	NOT RUN	N-D
22	2	43	BIS(2-CHLOROETHYOXY) METHANE	N-D	L 10	0	NOT RUN	N-D
22	2	44	METHYLENE CHLORIDE	45	29	35	NOT RUN	25
22	2	51	CHLORODIBROMOMETHANE	43	N-D	100	NOT RUN	L 10
22	2	54	ISOPHORONE	N-D	46	0	NOT RUN	N-D
22	2	55	NAPHTHALENE	17	L 10	41	NOT RUN	N-D
22	2	64	PENTACHLOROPHENOL	L 10	N-D	100	NOT RUN	N-D
22	2	66	BIS(2-ETHYLHEXYL) PHTHALATE	L 10	L 10	0	NOT RUN	164
22	2	67	BUTYL BENZYL PHTHALATE	L 10	N-D	100	NOT RUN	N-D
22	2	68	DI-N-BUTYL PHTHALATE	L 10	L 10	0	NOT RUN	N-D
22	2	69	DI-N-OCTYL PHTHALATE	N-D	L 10	0	NOT RUN	N-D
22	2	72	1,2-BENZANTHRACENE	N-D	L 10	0	NOT RUN	N-D
22	2	76	CHRYSENE	L 10	N-D	100	NOT RUN	N-D
22	2	78	ANTHRACENE	N-D	L 10	0	NOT RUN	N-D
22	2	80	FLUORENE	L 10	N-D	100	NOT RUN	N-D
22	2	85	TETRACHLOROETHYLENE	22	N-D	100	NOT RUN	N-D
22	2	86	TOLUENE	3600	1100	69	NOT RUN	L 10
22	2	102	ALPHA-BHC	N-D	N-D		NOT RUN	L 10
22	2	104	GAMMA-BHC	N-D	N-D		NOT RUN	L 10
22	2	114	ANTIMONY	L 2000	L 2000	0	NOT RUN	L 20
22	2	115	ARSENIC	L 2000	L 2000	0	NOT RUN	L 20
22	2	117	BERYLLIUM	L 10	L 10	0	NOT RUN	L 1
22	2	118	CADMIUM	160	L 20	87	NOT RUN	L 2
22	2	119	CHROMIUM	38100	4940	87	NOT RUN	L 5
22	2	120	COPPER	62800	2170	96	NOT RUN	L 6
22	2	121	CYANIDE	NOT RUN	1300		NOT RUN	L 5
22	2	122	LEAD	150000	32500	78	NOT RUN	21
22	2	123	MERCURY	NOT RUN	L 1		NOT RUN	NOT RUN
22	2	124	NICKEL	2410	L 50	97	NOT RUN	L 5
22	2	125	SELENIUM	L 2000	L 2000	0	NOT RUN	L 20
22	2	126	SILVER	L 10	L 10	0	NOT RUN	L 1
22	2	127	THALLIUM	L 2000	L 2000	0	NOT RUN	L 20
22	2	128	ZINC	2530	720	71	NOT RUN	L 60
22	2		PH(UNITS)	NOT RUN	13		NOT RUN	8
22	2		COD(MG-L)	NOT RUN	6810		NOT RUN	L 3
22	2		OIL & GREASE(MG-L)	NOT RUN	5384		NOT RUN	L 1
22	2		TOTAL PHENOLS	NOT RUN	400		NOT RUN	L 2
22	2		TOTAL SOLIDS(MG-L)	NOT RUN	15331		NOT RUN	333
22	2		TOTAL SUSP. SOLIDS(MG-L)	NOT RUN	1830		NOT RUN	L 5
22	2		ALUMINUM	31800	6710	78	NOT RUN	L 50
22	2		BARIUM	120000	4020	96	NOT RUN	47
22	2		IRON	200000	4260	97	NOT RUN	L 170
22	2		MANGANESE	1260	60	95	NOT RUN	6
22	2		CALCIUM(MG-L)	39	L 5	87	NOT RUN	51
22	2		MAGNESIUM(MG-L)	8	1	87	NOT RUN	12
22	2		COBALT	3110	670	78	NOT RUN	L 5
22	2		MOLYBDENUM	2760	2240	18	NOT RUN	L 5
22	2		TIN	460	L 50	89	NOT RUN	L 5
22	2		TITANIUM	5500	450	91	NOT RUN	L 15
22	2		VANADIUM	L 120	L 120	0	NOT RUN	L 12
22	2		YTTRIUM	L [illegible]	L 160	[illegible]	NOT RUN	L 16
22	2		SODIUM	22	344	0	NOT RUN	29

N-D: NOT DETECTED L: LESS THAN PP: PRIORITY POLLUTANT NUMBER
[illegible] POLLUTANTS NOT DETECTED ARE NOT LISTED.

PLANT	BATCH	PP	------PARAMETER----------	INFLUENT		EFFLUENT		REMOVAL(%)	SLUDGE	TAP WATER	
				ALL UNITS UG/L UNLESS OTHERWISE NOTED							
22	1	10	1,2-DICHLOROETHANE	L	10		NOT RUN	100	NOT RUN	L	10
22	1	23	CHLOROFORM	L	10		NOT RUN	100	NOT RUN	L	10
22	1	37	1,2-DIPHENYLHYDRAZINE		7600		N-D	100	NOT RUN		N-D
22	1	44	METHYLENE CHLORIDE		N-D		NOT RUN		NOT RUN		63
22	1	54	ISOPHORONE		44000		N-D	100	NOT RUN		N-D
22	1	55	NAPHTHALENE		N-D		110	0	NOT RUN		N-D
22	1	65	PHENOL	L	10		18	0	NOT RUN		N-D
22	1	66	BIS(2-ETHYLHEXYL) PHTHALATE	L	10		19	0	NOT RUN	L	10
22	1	68	DI-N-BUTYL PHTHALATE		N-D		10	0	NOT RUN	L	10
22	1	81	PHENANTHRENE		N-D		12	0	NOT RUN		N-D
22	1	86	TOLUENE	L	10		NOT RUN	100	NOT RUN	L	10
22	1	114	ANTIMONY	L	25	L	25	0	NOT RUN	L	10
22	1	115	ARSENIC	L	25	L	25	0	NOT RUN	L	25
22	1	117	BERYLLIUM	L	10	L	10	0	NOT RUN	L	10
22	1	118	CADMIUM		90	L	20	77	NOT RUN	L	20
22	1	119	CHROMIUM		10000	L	50	99	NOT RUN		2000
22	1	120	COPPER		10000	L	60	99	NOT RUN		300
22	1	121	CYANIDE		330		30	90	NOT RUN	L	20
22	1	122	LEAD		90000	L	200	99	NOT RUN		20000
22	1	123	MERCURY	L	5	L	5	0	NOT RUN	L	5
22	1	124	NICKEL	L	50	L	50	0	NOT RUN	L	50
22	1	125	SELENIUM	L	25	L	25	0	NOT RUN	L	25
22	1	126	SILVER	L	10	L	10	0	NOT RUN	L	10
22	1	127	THALLIUM	L	10	L	10	0	NOT RUN	L	10
22	1	128	ZINC		1000		1000	0	NOT RUN	L	600
22	1		PH(UNITS)		13		13		NOT RUN		9
22	1		BOD(MG-L)		21000		2600	87	NOT RUN	L	2
22	1		COD(MG-L)		32000		4800	85	NOT RUN		25
22	1		TOC(MG-L)		4000		940	76	NOT RUN		11
22	1		OIL & GREASE(MG-L)		2400		260	89	NOT RUN		3
22	1		TOTAL PHENOLS		330		30	90	NOT RUN	L	20
22	1		TOTAL SOLIDS(MG-L)		22600		5600	75	NOT RUN		181
22	1		TOTAL DISS. SOLIDS(MG-L)		21000		5500	73	NOT RUN		180
22	1		TOTAL SUSP. SOLIDS(MG-L)		1600		110	93	NOT RUN		1
22	1		TOTAL VOLATILE SOLIDS(MG-L)		6300		200	96	NOT RUN		20
22	1		VOLATILE DISS. SOLIDS(MG-L)		5300		153	97	NOT RUN		19
22	1		TOTAL VOL. SUS. SOLIDS(MG-L)		1000		47	95	NOT RUN		1
22	1		ALUMINUM		20000		600	97	NOT RUN		5000
22	1		BARIUM		20000		100	99	NOT RUN		1000
22	1		IRON		30000	L	2000	93	NOT RUN	L	2000
22	1		MANGANESE		400	L	50	87	NOT RUN	L	50
22	1		CALCIUM(MG-L)		71	L	50	29	NOT RUN	L	50
22	1		MAGNESIUM(MG-L)		13		9	30	NOT RUN		3
22	1		BORON	L	500	L	500	0	NOT RUN	L	500
22	1		COBALT		900	L	50	94	NOT RUN	L	50
22	1		MOLYBDENUM		700	L	50	92	NOT RUN		2000
22	1		TIN	L	50	L	50	0	NOT RUN	L	50
22	1		TITANIUM		3000		3000	0	NOT RUN		300
22	1		VANADIUM	L	100	L	100	0	NOT RUN	L	100
22	1		YTTRIUM	L	200	L	200	0	NOT RUN	L	200
22	1		SODIUM		3700		450	97	NOT RUN		2300

N-D NOT DETECTED; L-LESS THAN; PP- PRIORITY POLLUTANT NUMBER
PRIORITY POLLUTANTS NOT DETECTED IN ANY SAMPLES ARE NOT LISTED. FRACTIONS NOT ANALYZED ARE NOT LISTED.

ALL UNITS UG/L UNLESS OTHERWISE NOTED

PLANT	BATCH	PP	------PARAMETER----------	INFLUENT	EFFLUENT	REMOVAL(%)	SLUDGE	TAP WATER
23	1	23	CHLOROFORM	L 10	NOT RUN		NOT RUN	83
23	1	25	1,2-DICHLOROBENZENE	L 10	NOT RUN		NOT RUN	L 10
23	1	39	FLUORANTHENE	L 10	NOT RUN		NOT RUN	N-D
23	1	44	METHYLENE CHLORIDE	180	NOT RUN		NOT RUN	30
23	1	54	ISOPHORONE	N-D	NOT RUN		NOT RUN	L 10
23	1	55	NAPHTHALENE	14	NOT RUN		NOT RUN	L 10
23	1	65	PHENOL	L 10	NOT RUN		NOT RUN	N-D
23	1	66	BIS(2-ETHYLHEXYL) PHTHALATE	L 10	NOT RUN		NOT RUN	21
23	1	67	BUTYL BENZYL PHTHALATE	N-D	NOT RUN		NOT RUN	L 10
23	1	69	DI-N-BUTYL PHTHALATE	L 10	NOT RUN		NOT RUN	L 10
23	1	78	ANTHRACENE	L 10	NOT RUN		NOT RUN	N-D
23	1	81	PHENANTHRENE	L 10	NOT RUN		NOT RUN	N-D
23	1	86	TOLUENE	175	L 10	94	NOT RUN	21
23	1	114	ANTIMONY	L 25	NOT RUN		NOT RUN	NOT RUN
23	1	115	ARSENIC	L 25	NOT RUN		NOT RUN	NOT RUN
23	1	117	BERYLLIUM	L 5	NOT RUN		NOT RUN	L 1
23	1	118	CADMIUM	L 10	NOT RUN		NOT RUN	L 2
23	1	119	CHROMIUM	200	NOT RUN		NOT RUN	L 5
23	1	120	COPPER	100	NOT RUN		NOT RUN	L 10
23	1	121	CYANIDE	26	NOT RUN		NOT RUN	L 20
23	1	122	LEAD	4000	NOT RUN		NOT RUN	L 20
23	1	124	NICKEL	L 30	NOT RUN		NOT RUN	L 5
23	1	125	SELENIUM	L 25	NOT RUN		NOT RUN	NOT RUN
23	1	126	SILVER	L 5	NOT RUN		NOT RUN	L 1
23	1	127	THALLIUM	L 10	NOT RUN		NOT RUN	NOT RUN
23	1	128	ZINC	1000	NOT RUN		NOT RUN	L 60
23	1		PH(UNITS)	13	NOT RUN		NOT RUN	7
23	1		BOD(MG-L)	48	NOT RUN		NOT RUN	L 2
23	1		COD(MG-L)	190	NOT RUN		NOT RUN	24
23	1		TOC(MG-L)	46	NOT RUN		NOT RUN	13
23	1		OIL & GREASE(MG-L)	L 1	NOT RUN		NOT RUN	L 1
23	1		TOTAL PHENOLS	47	NOT RUN		NOT RUN	9
23	1		TOTAL SOLIDS(MG-L)	1100	NOT RUN		NOT RUN	190
23	1		TOTAL DISS. SOLIDS(MG-L)	980	NOT RUN		NOT RUN	184
23	1		TOTAL SUSP. SOLIDS(MG-L)	120	NOT RUN		NOT RUN	6
23	1		TOTAL VOLATILE SOLIDS(MG-L)	46	NOT RUN		NOT RUN	60
23	1		VOLATILE DISS. SOLIDS(MG-L)	NOT RUN	NOT RUN		NOT RUN	55
23	1		TOTAL VOL. SUS. SOLIDS(MG-L)	NOT RUN	NOT RUN		NOT RUN	5
23	1		ALUMINUM	1000	NOT RUN		NOT RUN	L 50
23	1		BARIUM	500	NOT RUN		NOT RUN	9
23	1		IRON	L 900	NOT RUN		NOT RUN	L 200
23	1		MANGANESE	L 30	NOT RUN		NOT RUN	L 5
23	1		CALCIUM(MG-L)	L 25	NOT RUN		NOT RUN	29
23	1		MAGNESIUM(MG-L)	3	NOT RUN		NOT RUN	7
23	1		BORON	L 300	NOT RUN		NOT RUN	L 50
23	1		COBALT	L 30	NOT RUN		NOT RUN	L 5
23	1		MOLYBDENUM	100	NOT RUN		NOT RUN	L 5
23	1		TIN	200	NOT RUN		NOT RUN	30
23	1		TITANIUM	L 80	NOT RUN		NOT RUN	L 20
23	1		VANADIUM	L 60	NOT RUN		NOT RUN	L 10
23	1		YTTRIUM	L 80	NOT RUN		NOT RUN	L 20
23	1		SODIUM	3700	NOT RUN		NOT RUN	L 15

N-D NOT DETECTED; L-LESS THAN; PP- PRIORITY POLLUTANT NUMBER
PRIORITY POLLUTANTS NOT DETECTED IN ANY SAMPLES ARE NOT LISTED. FRACTIONS NOT ANALYZED ARE NOT LISTED.

APPENDIX I

TABULATIONS OF ANSWERS TO SELECTED QUESTIONS FROM THE DATA COLLECTION PORTFOLIO

(Refer to Appendix A)

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03/21/78          FILE - INK       - CREATED 03/21/78

03          STATE

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)     (PCT)     (PCT)

                                 AL          2       0.4       0.4       0.4
                                 AR          2       0.4       0.4       0.9
                                 AZ          4       0.9       0.9       1.7
                                 CA         47      10.2      10.2      12.0
                                 CO          5       1.1       1.1      13.0
                                 CT          6       1.3       1.3      14.3
                                 DC          1       0.2       0.2      14.6
                                 FL         14       3.0       3.0      17.6
                                 GA         20       4.3       4.3      22.0
                                 HI          2       0.4       0.4      22.4
                                 IA          3       0.7       0.7      23.0
                                 IL         46      10.0      10.0      33.0
                                 IN          7       1.5       1.5      34.6
                                 KS          1       0.2       0.2      34.8
                                 KY          4       0.9       0.9      35.7
                                 LA          9       2.0       2.0      37.6
                                 MA         21       4.6       4.6      42.2
                                 MD          9       2.0       2.0      44.1
                                 MI         13       2.8       2.8      47.0
                                 MN          9       2.0       2.0      48.9
                                 MO         16       3.5       3.5      52.4
                                 MS          1       0.2       0.2      52.6
                                 NC         10       2.2       2.2      54.8
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                            NE         2        0.4        0.4      55.2
                            NH         2        0.4        0.4      55.7
                            NJ        39        8.5        8.5      64.1
                            NY        34        7.4        7.4      71.5
                            OH        28        6.1        6.1      77.6
                            OK         1        0.2        0.2      77.8
                            OR         7        1.5        1.5      79.3
                            PA        24        5.2        5.2      84.6
                            RI         1        0.2        0.2      84.8
                            SC         3        0.7        0.7      85.4
                            TN        13        2.8        2.8      88.3
                            TX        22        4.8        4.8      93.0
                            UT         3        0.7        0.7      93.7
                            VA         9        2.0        2.0      95.7
                            WA         6        1.3        1.3      97.0
                            WI        14        3.0        3.0     100.0
                                    ------     ------     ------
                            TOTAL    460      100.0      100.0

VALID CASES      460       MISSING CASES      0
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Q5        TYPE OF BUSINESS ORGANIZATION

                                                  RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)     (PCT)     (PCT)

PUBLIC CORP                     A        193       42.0      42.3      42.3

PRIVATE CORP                    B        247       53.7      54.2      96.5

PARTNERSHIP                     C          6        1.3       1.3      97.8

PROPRIETORSHIP                  D          9        2.0       2.0      99.8

COOPERATIVE                     E          1        0.2       0.2     100.0

                                           4        0.9    MISSING    100.0
                                      -------    -------    -------
                               TOTAL     460      100.0     100.0

VALID CASES      456       MISSING CASES      4
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03/21/78          FILE - INK      - CREATED 03/21/78

Q6        STATUS OF THE PLANT SITE

                                           RELATIVE  ADJUSTED    CUM
                                 ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE     FREQ     (PCT)     (PCT)     (PCT)

ONLY SITE                  A       128      27.8      28.2      28.2

BRANCH PLANT               B       293      63.7      64.5      92.7

DIVISION                   C        26       5.7       5.7      98.5

CAPTIVE SITE               D         7       1.5       1.5     100.0

                                     6       1.3    MISSING    100.0
                                 ------    ------    ------
                          TOTAL    460     100.0     100.0

VALID CASES      454       MISSING CASES      6


Q7        COST CENTER OR PROFIT CENTER

                                           RELATIVE  ADJUSTED    CUM
                                 ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE     FREQ     (PCT)     (PCT)     (PCT)

COST CENTER                A        22       4.8       6.9       6.9

PROFIT CENTER              B       297      64.6      93.1     100.0

                                   141      30.7    MISSING    100.0
                                 ------    ------    ------
                          TOTAL    460     100.0     100.0

VALID CASES      319       MISSING CASES    141
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03/21/78          FILE - INK      - CREATED 03/21/78

08        AVERAGE NUMBER OF EMPLOYEES

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE    FREQ       (PCT)     (PCT)     (PCT)

LESS THAN 10                    A       195       42.4      42.6      42.6

10 TO 20                        B       133       28.9      29.0      71.6

21 TO 30                        C        59       12.8      12.9      84.5

31 TO 40                        D        26        5.7       5.7      90.2

41 TO 50                        E        14        3.0       3.1      93.2

51 TO 60                        F         3        0.7       0.7      93.9

61 TO 70                        G         5        1.1       1.1      95.0

71 TO 80                        H         3        0.7       0.7      95.6

81 TO 90                        I         4        0.9       0.9      96.5

91 TO 100                       J         3        0.7       0.7      97.2

101 TO 150                      K         9        2.0       2.0      99.1

OVER 150                        L         4        0.9       0.9     100.0

                                          2        0.4    MISSING    100.0
                                     ------     ------    ------
                              TOTAL     460      100.0     100.0

VALID CASES     458      MISSING CASES     2
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q9        MAXIMUM 1976 EMPLOYMENT

                                                RELATIVE  ADJUSTED   CUM
                                      ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)     (PCT)    (PCT)

LESS THAN 10                    A        178      38.7      40.3     40.3

10 TO 20                        B        130      28.3      29.4     69.7

21 TO 30                        C         59      12.8      13.3     83.0

31 TO 40                        D         29       6.3       6.6     89.6

41 TO 50                        E         13       2.8       2.9     92.5

51 TO 60                        F          6       1.3       1.4     93.9

61 TO 70                        G          4       0.9       0.9     94.8

71 TO 80                        H          2       0.4       0.5     95.2

81 TO 90                        I          4       0.9       0.9     96.2

91 TO 100                       J          4       0.9       0.9     97.1

101 TO 150                      K          9       2.0       2.0     99.1

OVER 150                        L          4       0.9       0.9    100.0

                                          18       3.9   MISSING    100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     442      MISSING CASES     18
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q10         AGE OF PLANT

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)     (PCT)

LESS THAN 3                      A        49      10.7      10.9      10.9
3 TO 5                           B        51      11.1      11.4      22.3
6 TO 10                          C        98      21.3      21.9      44.2
11 TO 20                         D       126      27.4      28.1      72.3
21 TO 30                         E        60      13.0      13.4      85.7
OVER 30 YEARS                    F        64      13.9      14.3     100.0
                                          12       2.6   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     448     MISSING CASES     12


Q11       TOTAL 1976 VOLUME IN POUNDS

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)     (PCT)

UNDER 200000 LBS                 A       121      26.3      28.8      28.8
200000 TO 500000                 B        76      16.5      18.1      46.9
500K TO 1MM                      C        79      17.2      18.8      65.7
1MM TO 3MM                       D        75      16.3      17.9      83.6
OVER 3 MILLION                   E        69      15.0      16.4     100.0
                                          40       8.7   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     420     MISSING CASES     40
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q13       1976 PERCENT OF CAPACITY USED

                                                   RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)      (PCT)

0 TO 10                            A         5        1.1        1.3        1.3

11 TO 20                           B        19        4.1        4.8        6.0

21 TO 30                           C        26        5.7        6.5       12.6

31 TO 40                           D        77       16.7       19.3       31.9

41 TO 50                           E        59       12.8       14.8       46.7

51 TO 60                           F        46       10.0       11.6       58.3

61 TO 70                           G        59       12.8       14.8       73.1

71 TO 80                           H        48       10.4       12.1       85.2

81 TO 90                           I        30        6.5        7.5       92.7

91 TO 100                          J        29        6.3        7.3      100.0

                                            62       13.5     MISSING     100.0
                                         ------     ------     ------
                                  TOTAL    460      100.0      100.0

VALID CASES     398      MISSING CASES    62

Q14       AVERAGE ANNUAL PRODUCTION

                                                   RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)      (PCT)

UNDER 200000 LBS                   A       124       27.0       31.1       31.1

200000 TO 500000                   B        87       18.9       21.8       52.9

500K TO 1MM                        C        68       14.8       17.0       69.9

1MM TO 3MM                         D        59       12.8       14.8       84.7

OVER 3 MILLION                     E        61       13.3       15.3      100.0

                                            61       13.3     MISSING     100.0
                                         ------     ------     ------
                                  TOTAL    460      100.0      100.0

VALID CASES     399      MISSING CASES    61
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q16       MARKET VALUE OF PRODUCTION

                                                   RELATIVE  ADJUSTED    CUM
                                         ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE    FREQ      (PCT)     (PCT)     (PCT)

LESS THAN 250K                       A       85       18.5      22.8      22.8

250K TO 500K                         B       76       16.5      20.4      43.3

500K TO 750K                         C       40        8.7      10.8      54.0

750K TO 1MM                          D       31        6.7       8.3      62.4

1MM TO 1.25MM                        E       35        7.6       9.4      71.8

1.25MM TO 1.5MM                      F       14        3.0       3.8      75.5

1.5 TO 3MM                           G       49       10.7      13.2      88.7

OVER 3 MILLION                       H       42        9.1      11.3     100.0

                                             88       19.1   MISSING     100.0
                                          ------    ------    ------
                                   TOTAL    460      100.0     100.0

VALID CASES     372       MISSING CASES     88



Q17       NUMBER OF SHIFTS PER DAY

                                                   RELATIVE  ADJUSTED    CUM
                                         ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE    FREQ      (PCT)     (PCT)     (PCT)

ONE SHIFT                            A      373       81.1      81.3      81.3

TWO SHIFTS                           B       73       15.9      15.9      97.2

THREE SHIFTS                         C       13        2.8       2.8     100.0

                                              1        0.2   MISSING     100.0
                                          ------    ------    ------
                                   TOTAL    460      100.0     100.0

VALID CASES     459       MISSING CASES     1
```

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03/21/78          FILE - INK      - CREATED 03/21/78

018       LENGTH OF SHIFTS

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

7 HOURS                      A          7      1.5       1.6       1.6

8                            B        432     93.9      96.6      98.2

10                           C          7      1.5       1.6      99.8

12                           D          1      0.2       0.2     100.0

                                       13      2.8     MISSING   100.0
                                   -------  -------   -------
                           TOTAL      460    100.0     100.0

VALID CASES     447      MISSING CASES     13



020       NUMBER OF DAYS PER WEEK

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

LESS THAN 4                  A         10      2.2       2.2       2.2

5                            C        444     96.5      96.5      98.7

6                            D          6      1.3       1.3     100.0
                                   -------  -------   -------
                           TOTAL      460    100.0     100.0

VALID CASES     460      MISSING CASES      0
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03/21/78          FILE - INK      - CREATED 03/21/78

Q21       NUMBER OF TUBS LESS THAN 5 GALS

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE    FREQ     (PCT)     (PCT)     (PCT)

0                                A      123      26.7      41.0      41.0

1 TO 5                           B       72      15.7      24.0      65.0

6 TO 10                          C       45       9.8      15.0      80.0

10 TO 20                         D       46      10.0      15.3      95.3

20 TO 50                         E        9       2.0       3.0      98.3

OVER 50                          F        5       1.1       1.7     100.0

                                        160      34.8   MISSING     100.0
                                     ------    ------    ------
                               TOTAL    460     100.0     100.0

VALID CASES      300       MISSING CASES    160



Q22       TUBS 6 TO 10 GALS

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE    FREQ     (PCT)     (PCT)     (PCT)

0                                A      123      26.7      44.6      44.6

1 TO 5                           B       65      14.1      23.6      68.1

6 TO 10                          C       45       9.8      16.3      84.4

10 TO 20                         D       31       6.7      11.2      95.7

20 TO 50                         E        7       1.5       2.5      98.2

OVER 50                          F        5       1.1       1.8     100.0

                                        184      40.0   MISSING     100.0
                                     ------    ------    ------
                               TOTAL    460     100.0     100.0

VALID CASES      276       MISSING CASES    184
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03/21/78          FILE - INK      - CREATED 03/21/78

Q23       TUBS 10 TO 50 GALS

                                                    RELATIVE  ADJUSTED    CUM
                                          ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ      (PCT)     (PCT)     (PCT)

0                                 A          41        8.9      11.1      11.1

1 TO 5                            B         119       25.9      32.2      43.2

6 TO 10                           C          94       20.4      25.4      68.6

10 TO 20                          D          78       17.0      21.1      89.7

20 TO 50                          E          30        6.5       8.1      97.8

OVER 50                           F           8        1.7       2.2     100.0

                                             90       19.6    MISSING    100.0
                                          ------    ------    ------
                                  TOTAL     460      100.0     100.0

VALID CASES     370      MISSING CASES     90



Q24       TUBS 51 TO 100 GALS

                                                    RELATIVE  ADJUSTED    CUM
                                          ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ      (PCT)     (PCT)     (PCT)

0                                 A          54       11.7      15.9      15.9

1 TO 5                            B         107       23.3      31.6      47.5

6 TO 10                           C          96       20.9      28.3      75.8

10 TO 20                          D          61       13.3      18.0      93.8

20 TO 50                          E          17        3.7       5.0      98.8

OVER 50                           F           4        0.9       1.2     100.0

                                            121       26.3    MISSING    100.0
                                          ------    ------    ------
                                  TOTAL     460      100.0     100.0

VALID CASES     339      MISSING CASES    121
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03/21/78          FILE - INK      - CREATED 03/21/78

Q25       TUBS 101 TO 250 GALS

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ     (PCT)     (PCT)     (PCT)

0                             A        118      25.7      39.7      39.7

1 TO 5                        B        104      22.6      35.0      74.7

6 TO 10                       C         45       9.8      15.2      89.9

10 TO 20                      D         20       4.3       6.7      96.6

20 TO 50                      E         10       2.2       3.4     100.0

                                       163      35.4    MISSING    100.0
                                     ------    ------    ------
                             TOTAL     460     100.0     100.0

VALID CASES      297      MISSING CASES   163


Q26       TUBS 251 TO 500 GALS

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ     (PCT)     (PCT)     (PCT)

0                             A        162      35.2      65.6      65.6

1 TO 5                        B         54      11.7      21.9      87.4

6 TO 10                       C         12       2.6       4.9      92.3

10 TO 20                      D         11       2.4       4.5      96.8

20 TO 50                      E          6       1.3       2.4      99.2

OVER 50                       F          2       0.4       0.8     100.0

                                       213      46.3    MISSING    100.0
                                     ------    ------    ------
                             TOTAL     460     100.0     100.0

VALID CASES      247      MISSING CASES   213
```

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03/21/78          FILE - INK     - CREATED 03/21/78

027         TUBS 501 TO 1000 GALS

                                             RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE     FREQ      FREQ      FREQ
CATFGORY LABEL             CODE     FREQ      (PCT)     (PCT)     (PCT)

0                            A       188       40.9      83.6      83.6

1 TO 5                       B        27        5.9      12.0      95.6

6 TO 10                      C         4        0.9       1.8      97.3

10 TO 20                     D         6        1.3       2.7     100.0

                                     235       51.1   MISSING     100.0
                                  ------     ------    ------
                           TOTAL     460      100.0     100.0

VALID CASES      225       MISSING CASES    235



028         TUBS OVER 1000 GALS

                                             RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL             CODE     FREQ      (PCT)     (PCT)     (PCT)

0                            A       195       42.4      92.0      92.0

1 TO 5                       B        13        2.8       6.1      98.1

6 TO 10                      C         2        0.4       0.9      99.1

10 TO 20                     D         1        0.2       0.5      99.5

20 TO 50                     E         1        0.2       0.5     100.0

                                     248       53.9   MISSING     100.0
                                  ------     ------    ------
                           TOTAL     460      100.0     100.0

VALID CASES      212       MISSING CASES    248
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q29       NUMBER OF PRODUCTION DAYS PER YEAR

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)     (PCT)     (PCT)

150 TO 200                     A         13        2.8       2.9       2.9

201 TO 250                     B        219       47.6      48.1      51.0

251 TO 300                     C        204       44.3      44.8      95.8

301 TO 365                     D         17        3.7       3.7      99.6

UNDER 150                      E          2        0.4       0.4     100.0

                                          5        1.1   MISSING     100.0
                                     ------     ------    ------
                              TOTAL     460      100.0     100.0

VALID CASES     455      MISSING CASES     5



Q31       GALS OF WATER USED FOR ALL PURPOSES

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)     (PCT)     (PCT)

0 TO 10000                     A        376       81.7      86.8      86.8

10000 TO 20000                 B         32        7.0       7.4      94.2

20000 TO 30000                 C         13        2.8       3.0      97.2

30000 TO 50000                 D          6        1.3       1.4      98.6

50K TO 100K                    E          6        1.3       1.4     100.0

                                         27        5.9   MISSING     100.0
                                     ------     ------    ------
                              TOTAL     460      100.0     100.0

VALID CASES     433      MISSING CASES    27
```

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03/21/78          FILE - INK     - CREATED 03/21/78

033      PERCENT OF WATER USED IN PRODUCT

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)     (PCT)     (PCT)

0                                 A        201      43.7      47.3      47.3

1 TO 10                           B        151      32.8      35.5      82.8

11 TO  20                         C         24       5.2       5.6      88.5

21 TO 30                          D          8       1.7       1.9      90.4

31 TO 40                          E         18       3.9       4.2      94.6

41 TO 50                          F          6       1.3       1.4      96.0

51 TO 60                          G          1       0.2       0.2      96.2

61 TO 70                          H          3       0.7       0.7      96.9

71 TO 80                          I          5       1.1       1.2      98.1

81 TO 90                          J          4       0.9       0.9      99.1

91 TO 99                          K          3       0.7       0.7      99.8

100                               L          1       0.2       0.2     100.0

                                            35       7.6   MISSING     100.0
                                         ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES     425      MISSING CASES    35
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03/21/78          FILE - INK      - CREATED 03/21/78

Q34       PERCENT OF WATER FOR COOLING

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

0                               A         42       9.1       9.5       9.5

1 TO 10                         B         53      11.5      12.0      21.5

11 TO  20                       C         38       8.3       8.6      30.2

21 TO 30                        D         29       6.3       6.6      36.7

31 TO 40                        E         26       5.7       5.9      42.6

41 TO 50                        F         26       5.7       5.9      48.5

51 TO 60                        G         24       5.2       5.4      54.0

61 TO 70                        H         27       5.9       6.1      60.1

71 TO 80                        I         35       7.6       7.9      68.0

81 TO 90                        J         70      15.2      15.9      83.9

91 TO 99                        K         66      14.3      15.0      98.9

100                             L          5       1.1       1.1     100.0

                                          19       4.1   MISSING     100.0
                                      ------    ------    ------
                              TOTAL      460     100.0     100.0

VALID CASES     441      MISSING CASES     19
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q35        PERCENT OF WATER FOR BOILER FEED

                                          RELATIVE  ADJUSTED    CUM
                                ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL           CODE     FREQ     (PCT)     (PCT)     (PCT)

0                         A        229      49.8      59.5      59.5

1 TO 10                   B        136      29.6      35.3      94.8

11 TO   20                C         11       2.4       2.9      97.7

21 TO 30                  D          3       0.7       0.8      98.4

31 TO 40                  E          2       0.4       0.5      99.0

41 TO 50                  F          2       0.4       0.5      99.5

51 TO 60                  G          1       0.2       0.3      99.7

81 TO 90                  J          1       0.2       0.3     100.0

                                    75      16.3   MISSING     100.0
                                  ------    ------    ------
                         TOTAL     460     100.0     100.0

VALID CASES     385      MISSING CASES    75

Q36        PERCENT OF WATER FOR TUB CLEANING

                                          RELATIVE  ADJUSTED    CUM
                                ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL           CODE     FREQ     (PCT)     (PCT)     (PCT)

0                         A        179      38.9      44.9      44.9

1 TO 10                   B        167      36.3      41.9      86.7

11 TO   20                C         30       6.5       7.5      94.2

21 TO 30                  D         11       2.4       2.8      97.0

31 TO 40                  E          7       1.5       1.8      98.7

41 TO 50                  F          5       1.1       1.3     100.0

                                    61      13.3   MISSING     100.0
                                  ------    ------    ------
                         TOTAL     460     100.0     100.0

VALID CASES     399      MISSING CASES    61
```

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03/21/78          FILE - INK       - CREATED 03/21/78

037       PERCENT OF WATER USED  FOR SANITARY

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)     (PCT)

0                                 A       20       4.3       4.7       4.7

1 TO 10                           B      181      39.3      42.4      47.1

11 TO   20                        C       64      13.9      15.0      62.1

21 TO 30                          D       19       4.1       4.4      66.5

31 TO 40                          E       21       4.6       4.9      71.4

41 TO 50                          F       49      10.7      11.5      82.9

51 TO 60                          G       24       5.2       5.6      88.5

61 TO 70                          H       11       2.4       2.6      91.1

71 TO 80                          I       13       2.8       3.0      94.1

81 TO 90                          J        6       1.3       1.4      95.6

91 TO 99                          K       11       2.4       2.6      98.1

100                               L        8       1.7       1.9     100.0

                                          33       7.2   MISSING     100.0
                                      ------    ------    ------
                                TOTAL    460     100.0     100.0

VALID CASES     427     MISSING CASES     33
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03/21/78          FILE - INK      - CREATED 03/21/78

Q38       PERCENT OF WATER FOR AIR POLLUTION CONTR

                                                    RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                  CODE       FREQ      (PCT)      (PCT)      (PCT)

0                                 A         344       74.8       97.5       97.5

1 TO 10                           B           7        1.5        2.0       99.4

61 TO 70                          H           1        0.2        0.3       99.7

91 TO 99                          K           1        0.2        0.3      100.0

                                            107       23.3    MISSING      100.0
                                         -------    -------    -------
                                TOTAL       460      100.0      100.0

VALID CASES     353      MISSING CASES    107





Q39       PERCENT OF WATER FOR OTHER PURPOSES

                                                    RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                  CODE       FREQ      (PCT)      (PCT)      (PCT)

0                                 A         237       51.5       92.6       92.6

1 TO 10                           B          12        2.6        4.7       97.3

11 TO   20                        C           3        0.7        1.2       98.4

21 TO 30                          D           2        0.4        0.8       99.2

81 TO 90                          J           1        0.2        0.4       99.6

91 TO 99                          K           1        0.2        0.4      100.0

                                            204       44.3    MISSING      100.0
                                         -------    -------    -------
                                TOTAL       460      100.0      100.0

VALID CASES     256      MISSING CASES    204
```

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03/21/78          FILE - INK      - CREATED 03/21/78

040        GENERAL SALES

                                                 RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)     (PCT)     (PCT)

0                                A        11        2.4       2.6       2.6

1 TO 10                          B        14        3.0       3.3       5.9

11 TO   20                       C         5        1.1       1.2       7.1

21 TO 30                         D         2        0.4       0.5       7.5

31 TO 40                         E         4        0.9       0.9       8.5

41 TO 50                         F         3        0.7       0.7       9.2

51 TO 60                         G         2        0.4       0.5       9.7

61 TO 70                         H         9        2.0       2.1      11.8

71 TO 80                         I        14        3.0       3.3      15.1

81 TO 90                         J        22        4.8       5.2      20.3

91 TO 99                         K        40        8.7       9.4      29.7

100                              L       298       64.8      70.3     100.0

                                          36        7.8     MISSING   100.0
                                       ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     424      MISSING CASES     36
```

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03/21/78          FILE - INK       - CREATED 03/21/78

041        CAPTIVE PRODUCTION

                                                    RELATIVE  ADJUSTED    CUM
                                         ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE    FREQ       (PCT      (PCT)     (PCT)

0                                  A        302       65.7      73.8      73.8

1 TO 10                            B         34        7.4       8.3      82.2

11 TO   20                         C         22        4.8       5.4      87.5

21 TO 30                           D         11        2.4       2.7      90.2

31 TO 40                           E          8        1.7       2.0      92.2

41 TO 50                           F          3        0.7       0.7      92.9

51 TO 60                           G          3        0.7       0.7      93.6

61 TO 70                           H          3        0.7       0.7      94.4

71 TO 80                           I          4        0.9       1.0      95.4

81 TO 90                           J          4        0.9       1.0      96.3

91 TO 99                           K          7        1.5       1.7      98.0

100                                L          8        1.7       2.0     100.0

                                             51       11.1    MISSING    100.0
                                         ------     ------    ------
                                   TOTAL    460      100.0     100.0

VALID CASES     409      MISSING CASES    51
```

```
03/21/78          FILE - INK        - CREATED 03/21/78

Q42         PASTE INK PRODUCTION

                                                  RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)      (PCT)     (PCT)

0                                A        60        13.0       13.3      13.3
1 TO 10                          B        11         2.4        2.4      15.7
11 TO   20                       C        27         5.9        6.0      21.7
21 TO 30                         D        20         4.3        4.4      26.2
31 TO 40                         E        15         3.3        3.3      29.5
41 TO 50                         F        44         9.6        9.8      39.2
51 TO 60                         G        15         3.3        3.3      42.6
61 TO 70                         H        13         2.8        2.9      45.5
71 TO 80                         I        14         3.0        3.1      48.6
81 TO 90                         J        16         3.5        3.5      52.1
91 TO 99                         K        38         8.3        8.4      60.5
100                              L       178        38.7       39.5     100.0
                                           9         2.0    MISSING     100.0
                                      ------      ------     ------
                                TOTAL    460       100.0      100.0

VALID CASES      451      MISSING CASES      9
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

043       LIQUID INK PRODUCTION

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

0                             A        180      39.1      40.7      40.7
1 TO 10                       B         37       8.0       8.4      49.1
11 TO   20                    C         14       3.0       3.2      52.3
21 TO 30                      D         13       2.8       2.9      55.2
31 TO 40                      E         12       2.6       2.7      57.9
41 TO 50                      F         30       6.5       6.8      64.7
51 TO 60                      G         33       7.2       7.5      72.2
61 TO 70                      H         15       3.3       3.4      75.6
71 TO 80                      I         22       4.8       5.0      80.5
81 TO 90                      J         20       4.3       4.5      85.1
91 TO 99                      K         10       2.2       2.3      87.3
100                           L         56      12.2      12.7     100.0
                                        18       3.9   MISSING     100.0
                                    ------    ------    ------
                           TOTAL       460     100.0     100.0

VALID CASES     442      MISSING CASES    18
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q44          WATER BASE INK PRODUCTION

                                              RELATIVE  ADJUSTED   CUM
                                    ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)    (PCT)

0                              A       203      44.1      46.0     46.0
1 TO 10                        B       110      23.9      24.9     71.0
11 TO  20                      C        27       5.9       6.1     77.1
21 TO 30                       D        20       4.3       4.5     81.6
31 TO 40                       E        20       4.3       4.5     86.2
41 TO 50                       F        18       3.9       4.1     90.2
51 TO 60                       G         9       2.0       2.0     92.3
61 TO 70                       H         5       1.1       1.1     93.4
71 TO 80                       I         5       1.1       1.1     94.6
81 TO 90                       J         3       0.7       0.7     95.2
91 TO 99                       K         9       2.0       2.0     97.3
100                            L        12       2.6       2.7    100.0
                                        19       4.1   MISSING    100.0
                                    ------    ------    ------
                             TOTAL     460     100.0     100.0

VALID CASES     441      MISSING CASES     19
```

```
03/21/78            FILE - INK       - CREATED 03/21/78

045        OIL BASE INK PRODUCTION

                                                RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)      (PCT)      (PCT)

0                             A         65       14.1       14.5       14.5

1 TO 10                       B         17        3.7        3.8       18.3

11 TO   20                    C         31        6.7        6.9       25.2

21 TO 30                      D         20        4.3        4.5       29.7

31 TO 40                      E         20        4.3        4.5       34.2

41 TO 50                      F         35        7.6        7.8       42.0

51 TO 60                      G         16        3.5        3.6       45.5

61 TO 70                      H         16        3.5        3.6       49.1

71 TO 80                      I         14        3.0        3.1       52.2

81 TO 90                      J         16        3.5        3.6       55.8

91 TO 99                      K         49       10.7       10.9       66.7

100                           L        149       32.4       33.3      100.0

                                        12        2.6     MISSING     100.0
                                      ------    ------     ------
                            TOTAL      460      100.0      100.0

VALID CASES     448      MISSING CASES    12
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q46       SOLVENT BASE INK PRODUCTION

                                                 RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

0                                 A       221      48.0      50.6      50.6

1 TO 10                           B        32       7.0       7.3      57.9

11 TO  20                         C        15       3.3       3.4      61.3

21 TO 30                          D        19       4.1       4.3      65.7

31 TO 40                          E        21       4.6       4.8      70.5

41 TO 50                          F        46      10.0      10.5      81.0

51 TO 60                          G        12       2.6       2.7      83.8

61 TO 70                          H        11       2.4       2.5      86.3

71 TO 80                          I        11       2.4       2.5      88.8

81 TO 90                          J        14       3.0       3.2      92.0

91 TO 99                          K        13       2.8       3.0      95.0

100                               L        22       4.8       5.0     100.0

                                           23       5.0   MISSING     100.0
                                       ------    ------    ------
                                TOTAL     460     100.0     100.0

VALID CASES     437     MISSING CASES     23
```

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03/21/78          FILE - INK        - CREATED 03/21/78

047       ORGANIC PIGMENTS USED

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

0                               A        19       4.1       4.4       4.4
1 TO 10                         B        26       5.7       6.0      10.4
11 TO  20                       C        30       6.5       6.9      17.4
21 TO 30                        D        26       5.7       6.0      23.4
31 TO 40                        E        23       5.0       5.3      28.7
41 TO 50                        F        69      15.0      16.0      44.7
51 TO 60                        G        17       3.7       3.9      48.6
61 TO 70                        H        25       5.4       5.8      54.4
71 TO 80                        I        34       7.4       7.9      62.3
81 TO 90                        J        35       7.6       8.1      70.4
91 TO 99                        K        99      21.5      22.9      93.3
100                             L        29       6.3       6.7     100.0
                                         28       6.1   MISSING     100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES     432      MISSING CASES    28
```

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Q48      INORGANIC PIGMENT USAGE

                                               RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ       (PCT)     (PCT)     (PCT)

0                              A        32        7.0       7.6       7.6
1 TO 10                        B       117       25.4      27.7      35.3
11 TO  20                      C        34        7.4       8.1      43.4
21 TO 30                       D        33        7.2       7.8      51.2
31 TO 40                       E        21        4.6       5.0      56.2
41 TO 50                       F        57       12.4      13.5      69.7
51 TO 60                       G        35        7.6       8.3      78.0
61 TO 70                       H        24        5.2       5.7      83.6
71 TO 80                       I        19        4.1       4.5      88.2
81 TO 90                       J        19        4.1       4.5      92.7
91 TO 99                       K        17        3.7       4.0      96.7
100                            L        14        3.0       3.3     100.0
                                        38        8.3    MISSING    100.0
                                      ------    ------    ------
                             TOTAL     460      100.0     100.0

VALID CASES      422       MISSING CASES      38

Q49      VARNISH PRODUCTION AT THIS SITE

                                               RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ       (PCT)     (PCT)     (PCT)

YES                            A        91       19.8      20.1      20.1
NO                             B       361       78.5      79.9     100.0
                                         8        1.7    MISSING    100.0
                                      ------    ------    ------
                             TOTAL     460      100.0     100.0

VALID CASES      452       MISSING CASES       8
```

```
03/21/78          FILE - INK          - CREATED 03/21/78

Q50          WATER RINSE OF TUBS

                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL             CODE      FREQ      (PCT)      (PCT)      (PCT)

YES                          A        158       34.3      100.0      100.0

                                      302       65.7     MISSING     100.0
                                    ------     ------     ------
                           TOTAL      460      100.0      100.0

VALID CASES      158       MISSING CASES    302



Q51          CAUSTIC WASH OF TUBS

                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL             CODE      FREQ      (PCT)      (PCT)      (PCT)

YES                          B        111       24.1      100.0      100.0

                                      349       75.9     MISSING     100.0
                                    ------     ------     ------
                           TOTAL      460      100.0      100.0

VALID CASES      111       MISSING CASES    349



Q52          SOLVENT WASH OF TUBS

                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL             CODE      FREQ      (PCT)      (PCT)      (PCT)

YES                          C        308       67.0      100.0      100.0

                                      152       33.0     MISSING     100.0
                                    ------     ------     ------
                           TOTAL      460      100.0      100.0

VALID CASES      308       MISSING CASES    152
```

```
03/21/78         FILE - INK      - CREATED 03/21/78

053       DRY CLEAN  UP OF TUBS

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE      FREQ     (PCT)     (PCT)     (PCT)

YES                              D         106      23.0     100.0     100.0

                                           354      77.0   MISSING     100.0
                                         -------   -------   -------
                                TOTAL      460     100.0     100.0

VALID CASES      106      MISSING CASES   354


054       PERIODIC CAUSTIC SOAKING

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE      FREQ     (PCT)     (PCT)     (PCT)

YES                              E          85      18.5     100.0     100.0

                                           375      81.5   MISSING     100.0
                                         -------   -------   -------
                                TOTAL      460     100.0     100.0

VALID CASES       85      MISSING CASES   375


055       TYPE OF CAUSTIC       WASHING SYSTEM USED

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE      FREQ     (PCT)     (PCT)     (PCT)

CLOSED LOOP                      A          68      14.8      39.3      39.3

OPEN                             B          80      17.4      46.2      85.5

PARTIAL RECYCLE                  C          25       5.4      14.5     100.0

                                           287      62.4   MISSING     100.0
                                         -------   -------   -------
                                TOTAL      460     100.0     100.0

VALID CASES      173      MISSING CASES   287
```

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03/21/78          FILE - INK       - CREATED 03/21/78

Q56            WATER PRESSURE USED FOR WATER WASH

                                                    RELATIVE   ADJUSTED    CUM
                                          ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ     (PCT)      (PCT)     (PCT)

LESS THAN 50 PSI                   A         149      32.4       76.0      76.0

51 TO 100 PSI                      B          45       9.8       23.0      99.0

101 TO 150 PSI                     C           1       0.2        0.5      99.5

OVER 150 PSI                       D           1       0.2        0.5     100.0

                                             264      57.4    MISSING     100.0
                                          ------    ------     ------
                                 TOTAL       460     100.0      100.0

VALID CASES     196      MISSING CASES   264



Q57         FREQUENCY OF TUB CLEANING

                                                    RELATIVE   ADJUSTED    CUM
                                          ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ     (PCT)      (PCT)     (PCT)

ALL OF THE TIME                    A          62      13.5       14.0      14.0

MOST OF THE TIME                   B         238      51.7       53.6      67.6

OCCASSIONALLY                      C         133      28.9       30.0      97.5

NEVER                              D          11       2.4        2.5     100.0

                                              16       3.5    MISSING     100.0
                                          ------    ------     ------
                                 TOTAL       460     100.0      100.0

VALID CASES     444      MISSING CASES    16
```

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Q58       REUSE SPENT RINSE WATER IN NEXTBATCH

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

ALL OF THE TIME                  A        12        2.6       4.0       4.0

MOST OF THE TIME                 B        14        3.0       4.7       8.8

OCCASSIONALLY                    C        34        7.4      11.4      20.2

NEVER                            D       237       51.5      79.8     100.0

                                         163       35.4    MISSING    100.0
                                       ------     ------    ------
                                TOTAL    460      100.0     100.0

VALID CASES     297       MISSING CASES   163
Q59       REUSE SPENT RINSE WATER AS WASH WATER

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

ALL OF THE TIME                  A        46       10.0      15.5      15.5

MOST OF THE TIME                 B        38        8.3      12.8      28.4

OCCASSIONALLY                    C        40        8.7      13.5      41.9

NEVER                            D       172       37.4      58.1     100.0

                                         164       35.7    MISSING    100.0
                                       ------     ------    ------
                                TOTAL    460      100.0     100.0

VALID CASES     296       MISSING CASES   164
Q60       SPILL CLEAN UP BY DRY METHODS

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                              A       363       78.9      83.8      83.8

NO                               B        70       15.2      16.2     100.0

                                          27        5.9    MISSING    100.0
                                       ------     ------    ------
                                TOTAL    460      100.0     100.0

VALID CASES     433       MISSING CASES
```

```
Q61        FLOOR DRAINS TO STORM        SEWER

                                                RELATIVE  ADJUSTED     CUM
                                     ABSOLUTE    FREQ      FREQ       FREQ
CATEGORY LABEL              CODE       FREQ      (PCT)     (PCT)      (PCT)

YES                           A          61      13.3      14.3       14.3

NO                            B         367      79.8      85.7      100.0

                                         32       7.0     MISSING    100.0
                                     ------    ------    ------
                            TOTAL       460     100.0     100.0

VALID CASES      428       MISSING CASES    32

Q62        FLOOR DRAINS CONNECTED TO SANITARY SEWER

                                                RELATIVE  ADJUSTED     CUM
                                     ABSOLUTE    FREQ      FREQ       FREQ
CATEGORY LABEL              CODE       FREQ      (PCT)     (PCT)      (PCT)

YES                           A         170      37.0      39.3       39.3

NO                            B         263      57.2      60.7      100.0

                                         27       5.9     MISSING    100.0
                                     ------    ------    ------
                            TOTAL       460     100.0     100.0

VALID CASES      433       MISSING CASES    27



Q63        WATER USED TO WASH 1 TO 10 GAL TUB

                                                RELATIVE  ADJUSTED     CUM
                                     ABSOLUTE    FREQ      FREQ       FREQ
CATEGORY LABEL              CODE       FREQ      (PCT)     (PCT)      (PCT)

0 TO 5                        A         162      35.2      90.0       90.0

6 TO 10                       B          14       3.0       7.8       97.8

11 TO 50                      C           4       0.9       2.2      100.0

                                        280      60.9     MISSING    100.0
                                     ------    ------    ------
                            TOTAL       460     100.0     100.0

VALID CASES      180       MISSING CASES    280
```

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064       WATER USED TO WASH A  11 TO 50 GAL TUB

                                                 RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)     (PCT)     (PCT)

0 TO 5                           A       168       36.5      74.3      74.3

6 TO 10                          B        40        8.7      17.7      92.0

11 TO 50                         C        15        3.3       6.6      98.7

51 TO 100                        D         2        0.4       0.9      99.6

OVER 100                         E         1        0.2       0.4     100.0

                                         234       50.9   MISSING     100.0
                                       -------   -------   -------
                                TOTAL    460      100.0     100.0

VALID CASES     226       MISSING CASES   234



065       WATER USED TO WASH A 51 TO 100 GAL TUB

                                                 RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)     (PCT)     (PCT)

0 TO 5                           A       128       27.8      62.7      62.7

6 TO 10                          B        43        9.3      21.1      83.8

11 TO 50                         C        28        6.1      13.7      97.5

51 TO 100                        D         3        0.7       1.5      99.0

OVER 100                         E         2        0.4       1.0     100.0

                                         256       55.7   MISSING     100.0
                                       -------   -------   -------
                                TOTAL    460      100.0     100.0

VALID CASES     204       MISSING CASES   256
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q66       WATER USED TO WASH A 101 TO 250 GAL TUB

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

0 TO 5                         A         87       18.9      56.1      56.1
6 TO 10                        B         25        5.4      16.1      72.3
11 TO 50                       C         37        8.0      23.9      96.1
51 TO 100                      D          5        1.1       3.2      99.4
OVER 100                       E          1        0.2       0.6     100.0
                                        305       66.3    MISSING    100.0
                                     ------     ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES      155      MISSING CASES    305


Q67       WATER USED TO WASH A 251 TO 500 GAL TUB

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

0 TO 5                         A         70       15.2      66.7      66.7
6 TO 10                        B         16        3.5      15.2      81.9
11 TO 50                       C         13        2.8      12.4      94.3
51 TO 100                      D          4        0.9       3.8      98.1
OVER 100                       E          2        0.4       1.9     100.0
                                        355       77.2    MISSING    100.0
                                     ------     ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES      105      MISSING CASES    355
```

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03/21/78          FILE - INK       - CREATED 03/21/78

Q068      WATER USED TO WASH A 501 TO 1000 GAL  TU

                                          RELATIVE  ADJUSTED   CUM
                                ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL            CODE    FREQ     (PCT)     (PCT)    (PCT)

0 TO 5                      A      56      12.2      81.2     81.2
6 TO 10                     B       3       0.7       4.3     85.5
11 TO 50                    C       3       0.7       4.3     89.9
51 TO 100                   D       5       1.1       7.2     97.1
OVER 100                    E       2       0.4       2.9    100.0
                                  391      85.0   MISSING    100.0
                                -------   ------   ------
                          TOTAL   460     100.0     100.0

VALID CASES       69      MISSING CASES   391



Q069      WATER USED TO WASH A 1000 GAL OR MORE TU

                                          RELATIVE  ADJUSTED   CUM
                                ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL            CODE    FREQ     (PCT)     (PCT)    (PCT)

0 TO 5                      A      46      10.0      88.5     88.5
6 TO 10                     B       1       0.2       1.9     90.4
11 TO 50                    C       2       0.4       3.8     94.2
51 TO 100                   D       1       0.2       1.9     96.2
OVER 100                    E       2       0.4       3.8    100.0
                                  408      88.7   MISSING    100.0
                                -------   ------   ------
                          TOTAL   460     100.0     100.0

VALID CASES       52      MISSING CASES   408
```

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Q70       IS SOLVENT REDISTILLED?

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

YES                            A         38        8.3      10.9      10.9

NO                             B        311       67.6      89.1     100.0

                                        111       24.1    MISSING    100.0
                                     ------     ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES     349      MISSING CASES   111

Q71       IS SOLVENT REDISTILLED ONSITE

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

YES                            A          2        0.4       0.5       0.5

NO                             B        364       79.1      99.5     100.0

                                         94       20.4    MISSING    100.0
                                     ------     ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES     366      MISSING CASES    94


Q72       IS STEAM INJECTION DISTILLATION USED

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

NO                             B         55       12.0     100.0     100.0

                                        405       88.0    MISSING    100.0
                                     ------     ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES      55      MISSING CASES   405
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03/21/78          FILE - INK      - CREATED 03/21/78

Q73        STEAM CONDENSATE TO STORM SEWER

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

                                        460     100.0    MISSING    100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES        0       MISSING CASES   460

Q74        STEAM CONDENSATE TO SANITARY SEWER

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                             B         1       0.2     100.0     100.0

                                        459      99.8    MISSING    100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES        1       MISSING CASES   459



Q75        STEAM CONDENSATE MIXED WITH COOLING WATE

                                               RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

                                C         1       0.2     100.0     100.0

                                        459      99.8    MISSING    100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES        1       MISSING CASES   459
```

```
Q76       STEAM CONDENSATE MIXED WITH PROCESS WAST

                                                 RELATIVE  ADJUSTED     CUM
                                      ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                             D          1        0.2     100.0     100.0

                                         459       99.8   MISSING     100.0
                                      ------     ------    ------
                              TOTAL      460      100.0     100.0

VALID CASES        1      MISSING CASES   459


Q77       STEAM CONDENSATE DISPOSED OF OTHER METHO

                                                 RELATIVE  ADJUSTED     CUM
                                      ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                             E          3        0.7     100.0     100.0

                                         457       99.3   MISSING     100.0
                                      ------     ------    ------
                              TOTAL      460      100.0     100.0

VALID CASES        3      MISSING CASES   457



Q78       SPENT CAUSTIC TO SANITARY SEWER

                                                 RELATIVE  ADJUSTED     CUM
                                      ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                             A         43        9.3      18.5      18.5

NO                              B        189       41.1      81.5     100.0

                                         228       49.6   MISSING     100.0
                                      ------     ------    ------
                              TOTAL      460      100.0     100.0

VALID CASES      232      MISSING CASES   228
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q79       SPENT SOLVENT TO SANITARY SEWER

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)     (PCT)

YES                               A       26       5.7       6.5       6.5

NO                                B      374      81.3      93.5     100.0

                                          60      13.0   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     400      MISSING CASES     60

Q80       WET SCRUBBERS USED FOR AIR POLL

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)     (PCT)

YES                               A       10       2.2       2.3       2.3

NO                                B      421      91.5      97.7     100.0

                                          29       6.3   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     431      MISSING CASES     29

Q81       USE OF AFTERBURNERS IN PLANT

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)     (PCT)

YES                               A        3       0.7     100.0     100.0

                                         457      99.3   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES       3      MISSING CASES    457
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

082        USE OF ELECTROSTATIC PRECIPITATORS

                                             RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE     FREQ      FREQ     FREQ
CATEGORY LABEL            CODE      FREQ      (PCT)     (PCT)    (PCT)

YES                          B         2        0.4     100.0    100.0

                                     458       99.6   MISSING    100.0
                                  ------     ------    ------
                         TOTAL       460      100.0     100.0

VALID CASES        2      MISSING CASES   458


083        USE OF BAGHOUSE COLLECTORS

                                             RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE     FREQ      FREQ     FREQ
CATEGORY LABEL            CODE      FREQ      (PCT)     (PCT)    (PCT)

YES                          C        99       21.5     100.0    100.0

                                     361       78.5   MISSING    100.0
                                  ------     ------    ------
                         TOTAL       460      100.0     100.0

VALID CASES       99      MISSING CASES   361


084        USE OF CYCLONES

                                             RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE     FREQ      FREQ     FREQ
CATEGORY LABEL            CODE      FREQ      (PCT)     (PCT)    (PCT)

YES                          D         7        1.5     100.0    100.0

                                     453       98.5   MISSING    100.0
                                  ------     ------    ------
                         TOTAL       460      100.0     100.0

VALID CASES        7      MISSING CASES   453
```

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03/21/78          FILE - INK      - CREATED 03/21/78

085       USE OF FILTERS FOR AIR POLL CONTROL

                                           RELATIVE  ADJUSTED    CUM
                               ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL           CODE    FREQ       (PCT)     (PCT)     (PCT)

YES                        E        97       21.1     100.0     100.0

                                   363       78.9    MISSING    100.0
                                -------    ------    ------
                        TOTAL      460      100.0     100.0

VALID CASES       97      MISSING CASES   363

087       WET SCRUBBER WASTE COMBINED

                                           RELATIVE  ADJUSTED    CUM
                               ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL           CODE    FREQ       (PCT)     (PCT)     (PCT)

YES                        A         5        1.1     100.0     100.0

                                   455       98.9    MISSING    100.0
                                -------    ------    ------
                        TOTAL      460      100.0     100.0

VALID CASES        5      MISSING CASES   455

088       BOILER BLOWDOWN COMBINED

                                           RELATIVE  ADJUSTED    CUM
                               ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL           CODE    FREQ       (PCT)     (PCT)     (PCT)

YES                        B         7        1.5     100.0     100.0

                                   453       98.5    MISSING    100.0
                                -------    ------    ------
                        TOTAL      460      100.0     100.0

VALID CASES        7      MISSING CASES   453
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03/21/78          FILE - INK       - CREATED 03/21/78

089        BOILER CLEANING WASTE COMBINED

                                            RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                          C        4        0.9     100.0     100.0

                                     456      99.1    MISSING    100.0
                                  ------    ------    ------
                          TOTAL      460     100.0     100.0

VALID CASES       4      MISSING CASES   456


090        NON CONTACT COOLING        WATER COMBINED

                                            RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                          D       46       10.0     100.0     100.0

                                     414      90.0    MISSING    100.0
                                  ------    ------    ------
                          TOTAL      460     100.0     100.0

VALID CASES      46      MISSING CASES   414


091        SANITARY WASTEWATER COMBINED

                                            RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                          E       41        8.9     100.0     100.0

                                     419      91.1    MISSING    100.0
                                  ------    ------    ------
                          TOTAL      460     100.0     100.0

VALID CASES      41      MISSING CASES   419
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03/21/78          FILE - INK      - CREATED 03/21/78

092       LABORATORY WASTEWATER COMBINED

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE      FREQ     (PCT)     (PCT)     (PCT)

YES                         F         21       4.6     100.0     100.0

                                     439      95.4    MISSING    100.0
                                   ------    ------    ------
                           TOTAL     460     100.0     100.0

VALID CASES      21      MISSING CASES   439
093       STEAM CONDENSATE COMBINED

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE      FREQ     (PCT)     (PCT)     (PCT)

                            G          5       1.1     100.0     100.0

                                     455      98.9    MISSING    100.0
                                   ------    ------    ------
                           TOTAL     460     100.0     100.0

VALID CASES       5      MISSING CASES   455


095       VOLUME OF INK PROCESS WASTE GENERATED GP

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE      FREQ     (PCT)     (PCT)     (PCT)

0                           A        171      37.2      41.7      41.7

1 TO 100 GPD                B        171      37.2      41.7      83.4

101 TO 250                  C         33       7.2       8.0      91.5

251 TO 500                  D         12       2.6       2.9      94.4

501 TO 750                  E          6       1.3       1.5      95.9

751 TO 1000                 F          5       1.1       1.2      97.1

OVER 1000                   G         12       2.6       2.9     100.0

                                      50      10.9    MISSING    100.0
                                   ------    ------    ------
                           TOTAL     460     100.0     100.0

VALID CASES     410      MISSING CASES
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03/21/78          FILE - INK      - CREATED 03/21/78

Q96       PEAK VOLUME OF INK WASTE IN GPD

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ       (PCT)     (PCT)     (PCT)

0                                  A      147       32.0      40.4      40.4

1 TO 100 GPD                       B      141       30.7      38.7      79.1

101 TO 250                         C       39        8.5      10.7      89.8

251 TO 500                         D       13        2.8       3.6      93.4

501 TO 750                         E        7        1.5       1.9      95.3

751 TO 1000                        F        5        1.1       1.4      96.7

OVER 1000                          G       12        2.6       3.3     100.0

                                           96       20.9    MISSING    100.0
                                         ------    ------    ------
                                  TOTAL   460      100.0     100.0

VALID CASES      364       MISSING CASES     96
Q97       WASTE COMPLETELY REUSED

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ       (PCT)     (PCT)     (PCT)

YES                                A       14        3.0     100.0     100.0

                                          446       97.0    MISSING    100.0
                                         ------    ------    ------
                                  TOTAL   460      100.0     100.0

VALID CASES       14       MISSING CASES    446
Q98       WASTEWATER EVAPORATED

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ       (PCT)     (PCT)     (PCT)

YES                                B       34        7.4     100.0     100.0

                                          426       92.6    MISSING    100.0
                                         ------    ------    ------
                                  TOTAL   460      100.0     100.0

VALID CASES       34       MISSING CASES    426
```

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03/21/78          FILE - INK       - CREATED 03/21/78

099        WASTEWATER PARTIALLY REUSED

                                          RELATIVE  ADJUSTED    CUM
                                ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE    FREQ     (PCT)     (PCT)     (PCT)

YES                        C        45       9.8     100.0     100.0

                                   415      90.2    MISSING    100.0
                                ------    ------    ------
                          TOTAL    460     100.0     100.0

VALID CASES      45      MISSING CASES   415



0100       WASTEWATER DISCHARGED      TO CITY SEWE

                                          RELATIVE  ADJUSTED    CUM
                                ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE    FREQ     (PCT)     (PCT)     (PCT)

YES                        D       138      30.0     100.0     100.0

                                   322      70.0    MISSING    100.0
                                ------    ------    ------
                          TOTAL    460     100.0     100.0

VALID CASES     138      MISSING CASES   322



0101       WASTEWATER DISCHARGED TO STORM SEWER

                                          RELATIVE  ADJUSTED    CUM
                                ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE    FREQ     (PCT)     (PCT)     (PCT)

YES                        E        13       2.8     100.0     100.0

                                   447      97.2    MISSING    100.0
                                ------    ------    ------
                          TOTAL    460     100.0     100.0

VALID CASES      13      MISSING CASES   447
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q102      WASTEWATER DISCHARGED TO RECEIVING WATER

                                          RELATIVE   ADJUSTED    CUM
                                ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL          CODE      FREQ     (PCT)      (PCT)     (PCT)

YES                      F          4        0.9      100.0     100.0

                                  456       99.1     MISSING    100.0
                                -------    ------     ------
                        TOTAL     460      100.0      100.0

VALID CASES        4      MISSING CASES   456

Q103      WASTEWATER IMPOUNDED OR STORED

                                          RELATIVE   ADJUSTED    CUM
                                ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL          CODE      FREQ     (PCT)      (PCT)     (PCT)

YES                      G         14        3.0      100.0     100.0

                                  446       97.0     MISSING    100.0
                                -------    ------     ------
                        TOTAL     460      100.0      100.0

VALID CASES       14      MISSING CASES   446



Q104      WASTEWATER INCINERATED

                                          RELATIVE   ADJUSTED    CUM
                                ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL          CODE      FREQ     (PCT)      (PCT)     (PCT)

YES                      H          2        0.4      100.0     100.0

                                  458       99.6     MISSING    100.0
                                -------    ------     ------
                        TOTAL     460      100.0      100.0

VALID CASES        2      MISSING CASES   458
```

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03/21/78          FILE - INK       - CREATED 03/21/78

Q105      WASTEWATER DUMPED IN OCEAN

                                               RELATIVE  ADJUSTED   CUM
                                     ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)    (PCT)

YES                            I          2       0.4     100.0    100.0

                                        458      99.6   MISSING    100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES       2      MISSING CASES   458

Q106      WASTEWATER CONTRACT HAULED

                                               RELATIVE  ADJUSTED   CUM
                                     ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)    (PCT)

YES                            J        123      26.7     100.0    100.0

                                        337      73.3   MISSING    100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES     123      MISSING CASES   337



Q107      WASTEWATER LANDFILLED

                                               RELATIVE  ADJUSTED   CUM
                                     ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)    (PCT)

YES                            K         18       3.9     100.0    100.0

                                        442      96.1   MISSING    100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES      18      MISSING CASES   442
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03/21/78          FILE - INK       - CREATED 03/21/78

Q108      WASTEWATER TO DEEP WELL DISPOSAL

                                            RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                          L         1       0.2     100.0     100.0

                                     459      99.8   MISSING     100.0
                                  ------    ------    ------
                           TOTAL     460     100.0     100.0

VALID CASES        1      MISSING CASES   459




Q109      AVERAGE VOLUME INK PROCESS WASTE DISCHAR

                                            RELATIVE  ADJUSTED    CUM
                                  ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL             CODE     FREQ      (PCT)     (PCT)     (PCT)

0                            A       237      51.5      61.7      61.7

1 TO 100 GPD                 B        84      18.3      21.9      83.6

101 TO 250                   C        32       7.0       8.3      91.9

251 TO 500                   D        10       2.2       2.6      94.5

501 TO 750                   E         5       1.1       1.3      95.8

751 TO 1000                  F         5       1.1       1.3      97.1

OVER 1000                    G        11       2.4       2.9     100.0

                                      76      16.5   MISSING     100.0
                                  ------    ------    ------
                           TOTAL     460     100.0     100.0

VALID CASES      384      MISSING CASES    76
```

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Q110      PEAK VOLUME OF INK PROCESS WASTE DISCHAR

                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

0                            A          209       45.4      60.9      60.9

1 TO 100 GPD                 B           71       15.4      20.7      81.6

101 TO 250                   C           26        5.7       7.6      89.2

251 TO 500                   D           18        3.9       5.2      94.5

501 TO 750                   E            4        0.9       1.2      95.6

751 TO 1000                  F            3        0.7       0.9      96.5

OVER 1000                    G           12        2.6       3.5     100.0

                                        117       25.4    MISSING    100.0
                                      ------    ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES     343      MISSING CASES   117




Q111      DOES PLANT HAVE NPDES PERMIT


                                                RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL               CODE      FREQ      (PCT)     (PCT)     (PCT)

YES                          A           10        2.2       9.9       9.9

NO                           B           91       19.8      90.1     100.0

                                        359       78.0    MISSING    100.0
                                      ------    ------    ------
                             TOTAL      460      100.0     100.0

VALID CASES     101      MISSING CASES   359
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q112       HAS PLANT APPLIED FOR     NPDES PERMIT

                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE    FREQ      (PCT)      (PCT)     (PCT)

YES                            A        8        1.7        3.6       3.6

NO                             B      216       47.0       96.4     100.0

                                      236       51.3    MISSING     100.0
                                   ------     ------     ------
                             TOTAL    460      100.0      100.0

VALID CASES      224       MISSING CASES   236


Q113      DOES PLANT HAVE PERMIT FOR COOLING WATER

                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE    FREQ      (PCT)      (PCT)     (PCT)

YES                            A       19        4.1        8.0       8.0

NO                             B      218       47.4       92.0     100.0

                                      223       48.5    MISSING     100.0
                                   ------     ------     ------
                             TOTAL    460      100.0      100.0

VALID CASES      237       MISSING CASES   223


Q115      MUNICIPALITY USES WASTE        ORDINANCE

                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE    FREQ      (PCT)      (PCT)     (PCT)

YES                            A       84       18.3      100.0     100.0

                                      376       81.7    MISSING     100.0
                                   ------     ------     ------
                             TOTAL    460      100.0      100.0

VALID CASES       84       MISSING CASES   376
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q116      MUNICIPALITY IMPOSES SEWER USE CHARGES

                                              RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                           B       162       35.2     100.0     100.0

                                      298       64.8    MISSING    100.0
                                    ------     ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES     162      MISSING CASES   298


Q117      MUNICIPALITY SAMPLES PLANT WASTEWATER

                                              RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                           C        67       14.6     100.0     100.0

                                      393       85.4    MISSING    100.0
                                    ------     ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES      67      MISSING CASES   393


Q118      MUNICIPALITY     ISSUES SEWER PERMITS

                                              RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                           D        39        8.5     100.0     100.0

                                      421       91.5    MISSING    100.0
                                    ------     ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES      39      MISSING CASES   421
```

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Q119      MUNICIPALITY REQUIRES PLANT TO ANALYZE W

                                               RELATIVE   ADJUSTED    CUM
                                    ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE     FREQ      (PCT)      (PCT)     (PCT)

YES                           E        30        6.5       100.0     100.0

                                      430       93.5     MISSING     100.0
                                    -------    ------     ------
                             TOTAL    460      100.0      100.0

VALID CASES      30      MISSING CASES   430




Q120      PLANT WASTEWATER IS TREATED BEFORE DISPO

                                               RELATIVE   ADJUSTED    CUM
                                    ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE     FREQ      (PCT)      (PCT)     (PCT)

                              A        30        6.5        13.0      13.0

                              B       201       43.7        87.0     100.0

                                      229       49.8     MISSING     100.0
                                    -------    ------     ------
                             TOTAL    460      100.0      100.0

VALID CASES     231      MISSING CASES   229
```

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03/21/78          FILE - INK        - CREATED 03/21/78

Q121      INK PROCESS WASTE AS PERCENT OF TOTAL

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

0                                A        78       17.0      78.0      78.0

1 TO 20                          B         7        1.5       7.0      85.0

21 TO 40                         C         3        0.7       3.0      88.0

41 TO 60                         D         1        0.2       1.0      89.0

81 TO 99                         E         2        0.4       2.0      91.0

100                              G         9        2.0       9.0     100.0

                                         360       78.3    MISSING    100.0
                                       ------     ------    ------
                                TOTAL    460      100.0     100.0

VALID CASES      100      MISSING CASES   360




Q122      RESIN WASTE AS PERCENT OF TOTAL

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

0                                A        70       15.2      97.2      97.2

1 TO 20                          B         2        0.4       2.8     100.0

                                         388       84.3    MISSING    100.0
                                       ------     ------    ------
                                TOTAL    460      100.0     100.0

VALID CASES       72      MISSING CASES   388
```

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03/21/78          FILE - INK       - CREATED 03/21/78

0123      BOILER BLOWDOWN AS PER CENT OF TOTAL

                                                   RELATIVE  ADJUSTED   CUM
                                         ABSOLUTE   FREQ      FREQ     FREQ
CATEGORY LABEL                    CODE     FREQ     (PCT)     (PCT)    (PCT)

0                                  A        95      20.7      99.0     99.0

100                                G         1       0.2       1.0    100.0

                                           364      79.1    MISSING   100.0
                                         ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES      96      MISSING CASES   364




0124      AIR POLL WASTE AS PERCENT OF TOTAL

                                                   RELATIVE  ADJUSTED   CUM
                                         ABSOLUTE   FREQ      FREQ     FREQ
CATEGORY LABEL                    CODE     FREQ     (PCT)     (PCT)    (PCT)

0                                  A        73      15.9      98.6     98.6

1 TO 20                            B         1       0.2       1.4    100.0

                                           386      83.9    MISSING   100.0
                                         ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES      74      MISSING CASES   386
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03/21/78          FILE - INK      - CREATED 03/21/78

0125      SANITARY WASTE AS PERCENT OF TOTAL

                                             RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL               CODE    FREQ     (PCT)      (PCT)      (PCT)

0                             A       117      25.4       90.7       90.7

1 TO 20                       B         4       0.9        3.1       93.8

21 TO 40                      C         4       0.9        3.1       96.9

100                           G         4       0.9        3.1      100.0

                                      331      72.0    MISSING      100.0
                                   ------    ------     ------
                            TOTAL     460     100.0      100.0

VALID CASES      129      MISSING CASES    331




0126      COOLING WATER AS PERCENT OF  TOTAL

                                             RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL               CODE    FREQ     (PCT)      (PCT)      (PCT)

0                             A       122      26.5       87.8       87.8

1 TO 20                       B         2       0.4        1.4       89.2

21 TO 40                      C         1       0.2        0.7       89.9

41 TO 60                      D         2       0.4        1.4       91.4

61 TO  80                     E         3       0.7        2.2       93.5

81 TO 99                      F         4       0.9        2.9       96.4

100                           G         5       1.1        3.6      100.0

                                      321      69.8    MISSING      100.0
                                   ------    ------     ------
                            TOTAL     460     100.0      100.0

VALID CASES      139      MISSING CASES    321
```

```
Q127      OTHER WASTE AS PERCENT OF TOTAL

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

0                                A        39         8.5      95.1      95.1

1 TO 20                          B         1         0.2       2.4      97.6

81 TO 99                         F         1         0.2       2.4     100.0

                                         419        91.1   MISSING     100.0
                                       ------     ------    ------
                                TOTAL    460       100.0     100.0

VALID CASES      41      MISSING CASES   419

Q128      TREATMENT BY NEUTRALIZATION

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                              A         9         2.0     100.0     100.0

                                         451        98.0   MISSING     100.0
                                       ------     ------    ------
                                TOTAL    460       100.0     100.0

VALID CASES       9      MISSING CASES   451

Q129      TREATMENT BY SETTLING

                                                  RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                              B        36         7.8     100.0     100.0

                                         424        92.2   MISSING     100.0
                                       ------     ------    ------
                                TOTAL    460       100.0     100.0

VALID CASES      36      MISSING CASES   424
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q130      TREATMENT BY FLOTATION

                                            RELATIVE   ADJUSTED     CUM
                                  ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL              CODE    FREQ     (PCT)      (PCT)      (PCT)

                                     460     100.0     MISSING     100.0
                                   ------    ------     ------
                            TOTAL    460     100.0      100.0

VALID CASES        0      MISSING CASES   460



Q131      TREATMENT BY POLYMER

                                            RELATIVE   ADJUSTED     CUM
                                  ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL              CODE    FREQ     (PCT)      (PCT)      (PCT)

                                     460     100.0     MISSING     100.0
                                   ------    ------     ------
                            TOTAL    460     100.0      100.0

VALID CASES        0      MISSING CASES   460



Q132      LAGOON TREATMENT

                                            RELATIVE   ADJUSTED     CUM
                                  ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL              CODE    FREQ     (PCT)      (PCT)      (PCT)

YES                          E         3       0.7      100.0      100.0

                                     457      99.3     MISSING     100.0
                                   ------    ------     ------
                            TOTAL    460     100.0      100.0

VALID CASES        3      MISSING CASES   457
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

0133       CARBON ADSORPTION TREATMENT

                                             RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ     (PCT)     (PCT)     (PCT)

                                      460      100.0    MISSING    100.0
                                    ------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES        0       MISSING CASES   460

0134       TREATMENT BY EQUALIZATION

                                             RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ     (PCT)     (PCT)     (PCT)

YES                         G           3        0.7     100.0     100.0

                                      457       99.3    MISSING    100.0
                                    ------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES        3       MISSING CASES   457

0135       TREATMENT BY EVAPORATION

                                             RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ     (PCT)     (PCT)     (PCT)

YES                         H          11        2.4     100.0     100.0

                                      449       97.6    MISSING    100.0
                                    ------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES       11       MISSING CASES   449
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q136      TREATMENT BY LIME ADDITION

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

                                      460     100.0    MISSING    100.0
                                   ------    ------    ------
                           TOTAL      460     100.0     100.0

VALID CASES       0       MISSING CASES   460


Q137      TRICKLING FILTER TREATMENT

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                          J          1       0.2     100.0     100.0

                                      459      99.8    MISSING    100.0
                                   ------    ------    ------
                           TOTAL      460     100.0     100.0

VALID CASES       1       MISSING CASES   459


Q138      TREATMNT BY GRAVITY SEPARATION

                                             RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                          K         19       4.1     100.0     100.0

                                      441      95.9    MISSING    100.0
                                   ------    ------    ------
                           TOTAL      460     100.0     100.0

VALID CASES      19       MISSING CASES   441
```

```
Q139      TREATMENT BY FILTRATION

                                                      RELATIVE  ADJUSTED    CUM
                                           ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE      FREQ      (PCT)     (PCT)     (PCT)

YES                                  L          4        0.9     100.0     100.0

                                              456       99.1    MISSING    100.0
                                           ------     ------    ------
                                  TOTAL       460      100.0     100.0

VALID CASES        4       MISSING CASES    456


Q140      TREATMENT BY ALUM ADDITION

                                                      RELATIVE  ADJUSTED    CUM
                                           ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE      FREQ      (PCT)     (PCT)     (PCT)

YES                                  M          2        0.4     100.0     100.0

                                              458       99.6    MISSING    100.0
                                           ------     ------    ------
                                  TOTAL       460      100.0     100.0

VALID CASES        2       MISSING CASES    458


Q141      ACTIVATED SLUDGE TREATMENT

                                                      RELATIVE  ADJUSTED    CUM
                                           ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE      FREQ      (PCT)     (PCT)     (PCT)

YES                                  N          7        1.5     100.0     100.0

                                              453       98.5    MISSING    100.0
                                           ------     ------    ------
                                  TOTAL       460      100.0     100.0

VALID CASES        7       MISSING CASES    453
```

```
03/21/78          FILE - INK        - CREATED 03/21/78

Q142      BATCH OR CONTINUOUS TREATMENT SYSTEM

                                                  RELATIVE   ADJUSTED    CUM
                                        ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ      (PCT)      (PCT)     (PCT)

BATCH                              A        34       7.4       55.7      55.7

CONTINUOUS                         B        27       5.9       44.3     100.0

                                           399      86.7     MISSING    100.0
                                         ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES      61      MISSING CASES   399


Q143      BATCH OR CONTINUOUS WASTEWATER DISCHARGE

                                                  RELATIVE   ADJUSTED    CUM
                                        ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ      (PCT)      (PCT)     (PCT)

BATCH                              A        73      15.9       70.9      70.9

CONTINUOUS                         B        30       6.5       29.1     100.0

                                           357      77.6     MISSING    100.0
                                         ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES     103      MISSING CASES   357
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q144      YEAR WASTEWATER TREATMENT SYSTEM WAS INS

                                                 RELATIVE  ADJUSTED    CUM
                                         ABSOLUTE   FREQ      FREQ     FREQ
CATEGORY LABEL                     CODE    FREQ    (PCT)     (PCT)    (PCT)

                                     56       1      0.2       2.6      2.6

                                     57       1      0.2       2.6      5.3

                                     60       1      0.2       2.6      7.9

                                     61       1      0.2       2.6     10.5

                                     62       1      0.2       2.6     13.2

                                     68       3      0.7       7.9     21.1

                                     69       4      0.9      10.5     31.6

                                     70       2      0.4       5.3     36.8

                                     72       3      0.7       7.9     44.7

                                     73       2      0.4       5.3     50.0

                                     74       2      0.4       5.3     55.3

                                     75       8      1.7      21.1     76.3

                                     76       5      1.1      13.2     89.5

                                     77       4      0.9      10.5    100.0

                                            422     91.7   MISSING    100.0
                                          -------  -------  -------
                                  TOTAL     460    100.0     100.0

VALID CASES       38       MISSING CASES   422
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03/21/78          FILE - INK      - CREATED 03/21/78

0145       INSTALLED CAPITAL COST OF TREATMENT SYST

                                                 RELATIVE   ADJUSTED    CUM
                                       ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)      (PCT)     (PCT)

                                 50.       1        0.2        3.0       3.0
                                100.       3        0.7        9.1      12.1
                                400.       1        0.2        3.0      15.2
                                600.       1        0.2        3.0      18.2
                                700.       2        0.4        6.1      24.2
                               1000.       1        0.2        3.0      27.3
                               1340.       1        0.2        3.0      30.3
                               1500.       2        0.4        6.1      36.4
                               1800.       1        0.2        3.0      39.4
                               2000.       3        0.7        9.1      48.5
                               4000.       1        0.2        3.0      51.5
                               6100.       1        0.2        3.0      54.5
                              10000.       3        0.7        9.1      63.6
                              11000.       1        0.2        3.0      66.7
                              11178.       1        0.2        3.0      69.7
                              15000.       4        0.9       12.1      81.8
                              17000.       1        0.2        3.0      84.8
                              18000.       2        0.4        6.1      90.9
                              20000.       1        0.2        3.0      93.9
                              25000.       1        0.2        3.0      97.0
                              55000.       1        0.2        3.0     100.0
                                  0.     427       92.8     MISSING    100.0
                                       ------     ------     ------
                               TOTAL     460      100.0      100.0
```

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03/21/78          FILE - INK      - CREATED 03/21/78

0146       ANNUAL OPERATION COSTS OF TREATMENT SYST

                                               RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ       (PCT)     (PCT)     (PCT)

                             10.        1         0.2       4.0       4.0
                             45.        1         0.2       4.0       8.0
                            100.        3         0.7      12.0      20.0
                            150.        1         0.2       4.0      24.0
                            240.        1         0.2       4.0      28.0
                            260.        1         0.2       4.0      32.0
                            600.        1         0.2       4.0      36.0
                           1000.        8         1.7      32.0      68.0
                           2000.        4         0.9      16.0      84.0
                           3000.        1         0.2       4.0      88.0
                           5000.        2         0.4       8.0      96.0
                           9000.        1         0.2       4.0     100.0
                              0.      435        94.6    MISSING    100.0
                                   ------      ------    ------
                           TOTAL      460       100.0     100.0
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q149      SLUDGE STORED ON PLANT PROPERTY

                                                     RELATIVE   ADJUSTED    CUM
                                          ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ      (PCT)      (PCT)     (PCT)

YES                                A          2        0.4      100.0     100.0

                                            458       99.6     MISSING    100.0
                                          ------     ------    ------
                                  TOTAL     460      100.0      100.0

VALID CASES       2      MISSING CASES   458

Q150      SLUDGE INCINERATED

                                                     RELATIVE   ADJUSTED    CUM
                                          ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ      (PCT)      (PCT)     (PCT)

YES                                B          3        0.7      100.0     100.0

                                            457       99.3     MISSING    100.0
                                          ------     ------    ------
                                  TOTAL     460      100.0      100.0

VALID CASES       3      MISSING CASES   457

Q151      SLUDGE IS SOLD

                                                     RELATIVE   ADJUSTED    CUM
                                          ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE      FREQ      (PCT)      (PCT)     (PCT)

YES                                C          2        0.4      100.0     100.0

                                            458       99.6     MISSING    100.0
                                          ------     ------    ------
                                  TOTAL     460      100.0      100.0

VALID CASES       2      MISSING CASES   458
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q152        SLUDGE IS CONTRACT HAULED

                                              RELATIVE   ADJUSTED    CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE    FREQ       (PCT)      (PCT)     (PCT)

YES                            D        59       12.8      100.0     100.0

                                       401       87.2     MISSING    100.0
                                    ------     ------     ------
                             TOTAL     460      100.0      100.0

VALID CASES       59       MISSING CASES   401

Q153        SLUDGE IS RECLAIMED

                                              RELATIVE   ADJUSTED    CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE    FREQ       (PCT)      (PCT)     (PCT)

                                       460      100.0     MISSING    100.0
                                    ------     ------     ------
                             TOTAL     460      100.0      100.0

VALID CASES        0       MISSING CASES   460


Q154        SLUDGE TRUCKED TO LANDFILL BY PLANT

                                              RELATIVE   ADJUSTED    CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL               CODE    FREQ       (PCT)      (PCT)     (PCT)

                               F         9        2.0      100.0     100.0

                                       451       98.0     MISSING    100.0
                                    ------     ------     ------
                             TOTAL     460      100.0      100.0

VALID CASES        9       MISSING CASES   451
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q156      IS SLUDGE CONDITIONED

                                               RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL              CODE       FREQ      (PCT)      (PCT)      (PCT)

YES                          A            3       0.7        2.5        2.5

NO                           B          119      25.9       97.5      100.0

                                        338      73.5     MISSING     100.0
                                     ------    ------     ------
                            TOTAL       460     100.0      100.0

VALID CASES      122      MISSING CASES   338


Q157      CONTRACTOR USES PUBLIC LANDFILL

                                               RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL              CODE       FREQ      (PCT)      (PCT)      (PCT)

YES                          A           50      10.9      100.0      100.0

                                        410      89.1     MISSING     100.0
                                     ------    ------     ------
                            TOTAL       460     100.0      100.0

VALID CASES       50      MISSING CASES   410


Q158      CONTRACTOR USES         PRIVATE LANDFILL

                                               RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL              CODE       FREQ      (PCT)      (PCT)      (PCT)

YES                          B           71      15.4      100.0      100.0

                                        389      84.6     MISSING     100.0
                                     ------    ------     ------
                            TOTAL       460     100.0      100.0

VALID CASES       71      MISSING CASES   389
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q159      CONTRACTOR INCINERATES SLUDGE

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                                C        17       3.7      100.0     100.0

                                           443      96.3    MISSING     100.0
                                         ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES      17      MISSING CASES    443


Q160      CONTRACTOR RECLAIMS SLUDGE

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                                D        22       4.8      100.0     100.0

                                           438      95.2    MISSING     100.0
                                         ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES      22      MISSING CASES    438


Q161      CONTRACTOR DISPOSAL METHOD  UNKNOWN

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                                E       144      31.3      100.0     100.0

                                           316      68.7    MISSING     100.0
                                         ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES     144      MISSING CASES    316
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03/21/78          FILE - INK       - CREATED 03/21/78

Q163       COST PER GALLON OF SLUDGE DISPOSAL

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ     (PCT)     (PCT)     (PCT)

                                    1.       4      0.9       0.9      79.3
                                    2.       2      0.4       0.4      79.8
                                    3.       7      1.5       1.5      81.3
                                    4.       1      0.2       0.2      81.5
                                    5.       6      1.3       1.3      82.8
                                    6.       5      1.1       1.1      83.9
                                    7.       2      0.4       0.4      84.3
                                    8.       2      0.4       0.4      84.8
                                    9.       4      0.9       0.9      85.7
                                   10.      14      3.0       3.0      88.7
                                   11.       4      0.9       0.9      89.6
                                   12.       4      0.9       0.9      90.4
                                   14.       2      0.4       0.4      90.9
                                   15.       6      1.3       1.3      92.2
                                   16.       2      0.4       0.4      92.6
                                   17.       1      0.2       0.2      92.8
                                   18.       1      0.2       0.2      93.0
                                   19.       1      0.2       0.2      93.3
                                   20.       3      0.7       0.7      93.9
                                   21.       1      0.2       0.2      94.1
                                   23.       1      0.2       0.2      94.3
                                   25.       3      0.7       0.7      95.0
```

```
                          26.      4      0.9      0.9     95.9
                          27.      2      0.4      0.4     96.3
                          28.      1      0.2      0.2     96.5
                          30.      7      1.5      1.5     98.0
                          32.      1      0.2      0.2     98.3
                          34.      1      0.2      0.2     98.5
                          40.      3      0.7      0.7     99.1
                          43.      1      0.2      0.2     99.3
                          47.      1      0.2      0.2     99.6
                          50.      1      0.2      0.2     99.8
                          69.      1      0.2      0.2    100.0
                               -------  -------  -------
                         TOTAL    460    100.0    100.0
```

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Q164      PERCENT OF          FLOW BECOMING SLUDGE

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)     (PCT)     (PCT)

0 TO 5                          A         40       8.7      71.4      71.4

6 TO 10                         B          8       1.7      14.3      85.7

11 TO 15                        C          8       1.7      14.3     100.0

                                         404      87.8    MISSING    100.0
                                      ------    ------    ------
                                TOTAL    460     100.0     100.0

VALID CASES      56      MISSING CASES   404

Q165      OFFSPEC INK DISCHARGED WITH WATER

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)     (PCT)     (PCT)

YES                             A          3       0.7     100.0     100.0

                                         457      99.3    MISSING    100.0
                                      ------    ------    ------
                                TOTAL    460     100.0     100.0

VALID CASES       3      MISSING CASES   457


Q166      OFFSPEC INK SOLD TO SCAVENGERS

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)     (PCT)     (PCT)

YES                             B         42       9.1     100.0     100.0

                                         418      90.9    MISSING    100.0
                                      ------    ------    ------
                                TOTAL    460     100.0     100.0

VALID CASES      42      MISSING CASES   418
```

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03/21/78          FILE - INK      - CREATED 03/21/78

Q167      OFFSPEC INK GIVEN TO    SCAVENGERS

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                             C         85      18.5     100.0     100.0

                                         375      81.5   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES      85      MISSING CASES   375


Q168      OFFSPEC INK BLENDED INTO OTHER PRODUCT

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                             D        378      82.2     100.0     100.0

                                          82      17.8   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES     378      MISSING CASES    82


Q169      OTHER DISPOSITION OF OFFSPEC INK

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

                               GIVE        1       0.2      33.3      33.3

                               HAUL        1       0.2      33.3      66.7

                               PAY         1       0.2      33.3     100.0

                                         457      99.3   MISSING     100.0
                                      ------    ------    ------
                               TOTAL     460     100.0     100.0

VALID CASES       3      MISSING CASES   457
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q170      PLANT HAS PH ANALYSIS OF WASTEWATER

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                            A        53      11.5     100.0     100.0

                                       407      88.5    MISSING    100.0
                                    ------    ------    ------
                             TOTAL     460     100.0     100.0

VALID CASES       53      MISSING CASES   407


Q171      PLANT HAS BOD ANALYSIS OF WASTEWATER

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                            B        33       7.2     100.0     100.0

                                       427      92.8    MISSING    100.0
                                    ------    ------    ------
                             TOTAL     460     100.0     100.0

VALID CASES       33      MISSING CASES   427


Q172      PLANT HAS COD ANALYSIS OF WASTEWATER

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                            C        18       3.9     100.0     100.0

                                       442      96.1    MISSING    100.0
                                    ------    ------    ------
                             TOTAL     460     100.0     100.0

VALID CASES       18      MISSING CASES   442
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q173       PLANT HAS SUSP SOLIDS ANALYSIS

                                                RELATIVE  ADJUSTED     CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                             D         32       7.0     100.0     100.0

                                         428      93.0    MISSING    100.0
                                       -------   -------   -------
                               TOTAL     460     100.0     100.0

VALID CASES      32      MISSING CASES   428

Q174       PLANT HAS TOTAL SOLIDS ANALSIS OF WASTEW

                                                RELATIVE  ADJUSTED     CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                             E         19       4.1     100.0     100.0

                                         441      95.9    MISSING    100.0
                                       -------   -------   -------
                               TOTAL     460     100.0     100.0

VALID CASES      19      MISSING CASES   441

Q175       PLANT HAS METALS ANALYSIS OF WASTEWATER

                                                RELATIVE  ADJUSTED     CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

YES                             F         19       4.1     100.0     100.0

                                         441      95.9    MISSING    100.0
                                       -------   -------   -------
                               TOTAL     460     100.0     100.0

VALID CASES      19      MISSING CASES   441
```

```
Q176      PLANT HAS OIL AND GREASE ANALYSIS

                                              RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                           G        17        3.7     100.0     100.0

                                      443       96.3   MISSING     100.0
                                   -------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES       17      MISSING CASES   443


Q177      PLANT HAS TURBIDITY ANALYSIS OF WASTEWAT

                                              RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                           H         5        1.1     100.0     100.0

                                      455       98.9   MISSING     100.0
                                   -------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES        5      MISSING CASES   455


Q178      PLANT HAS TRACE ORGANICS ANALYSIS

                                              RELATIVE  ADJUSTED    CUM
                                   ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)     (PCT)     (PCT)

YES                           I         5        1.1     100.0     100.0

                                      455       98.9   MISSING     100.0
                                   -------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES        5      MISSING CASES   455
```

```
03/21/78           FILE - INK      - CREATED 03/21/78

Q180       NEW CAP COST FOR BASELINE WATER POLL REG

                                                      RELATIVE  ADJUSTED    CUM
                                             ABSOLUTE   FREQ      FREQ     FREQ
CATEGORY LABEL                        CODE     FREQ     (PCT)     (PCT      (PCT)

                                      500.       1        0.2       2.4      2.4
                                     3200.       1        0.2       2.4      4.8
                                     4000.       1        0.2       2.4      7.1
                                     5000.       2        0.4       4.8     11.9
                                     6000.       1        0.2       2.4     14.3
                                     7500.       1        0.2       2.4     16.7
                                    10000.      11        2.4      26.2     42.9
                                    12000.       1        0.2       2.4     45.2
                                    15000.       2        0.4       4.8     50.0
                                    20000.       4        0.9       9.5     59.5
                                    25000.       3        0.7       7.1     66.7
                                    30000.       3        0.7       7.1     73.8
                                    38000.       1        0.2       2.4     76.2
                                    40000.       1        0.2       2.4     78.6
                                    50000.       2        0.4       4.8     83.3
                                    60000.       2        0.4       4.8     88.1
                                    80000.       1        0.2       2.4     90.5
                                   125000.       1        0.2       2.4     92.9
                                   150000.       1        0.2       2.4     95.2
                                   175000.       1        0.2       2.4     97.6
                                  1500000.       1        0.2       2.4    100.0
                                        0.     418       90.9   MISSING    100.0
                                             ------    ------    ------
                                     TOTAL     460      100.0     100.0
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q181      ANNUAL OPER COSTS FOR BASELINE WATER REG

                                              RELATIVE  ADJUSTED     CUM
                                   ABSOLUTE     FREQ      FREQ       FREQ
CATEGORY LABEL             CODE      FREQ      (PCT)     (PCT)      (PCT)

                             0.       409      88.9      88.9       88.9
                           175.         1       0.2       0.2       89.1
                           500.         2       0.4       0.4       89.6
                           700.         1       0.2       0.2       89.8
                           800.         1       0.2       0.2       90.0
                          1000.         8       1.7       1.7       91.7
                          1200.         1       0.2       0.2       92.0
                          1500.         3       0.7       0.7       92.6
                          1831.         1       0.2       0.2       92.8
                          2000.         5       1.1       1.1       93.9
                          2500.         1       0.2       0.2       94.1
                          3000.         3       0.7       0.7       94.8
                          3500.         2       0.4       0.4       95.2
                          4000.         5       1.1       1.1       96.3
                          4500.         1       0.2       0.2       96.5
                          5000.         5       1.1       1.1       97.6
                          6000.         3       0.7       0.7       98.3
                          9000.         1       0.2       0.2       98.5
                         12000.         3       0.7       0.7       99.1
                         15000.         2       0.4       0.4       99.6
                         20000.         1       0.2       0.2       99.8
                        135000.         1       0.2       0.2      100.0
                                   ------    ------    ------
                          TOTAL       460     100.0     100.0
```

```
Q182.     ODOR REGS TO HAVE ECONOMIC IMPACT ON PLA

                                               RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL               CODE      FREQ     (PCT)      (PCT)      (PCT)

YES                           A          9       2.0      100.0      100.0

                                        451      98.0     MISSING    100.0
                                     -------   -------   -------
                             TOTAL      460     100.0      100.0

VALID CASES        9      MISSING CASES   451


Q183      THERMAL REGS TO HAVE ECONOMIC IMPACT

                                               RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL               CODE      FREQ     (PCT)      (PCT)      (PCT)

YES                           B          5       1.1      100.0      100.0

                                        455      98.9     MISSING    100.0
                                     -------   -------   -------
                             TOTAL      460     100.0      100.0

VALID CASES        5      MISSING CASES   455


Q184      SOLID WASTE REGS TO HAVE ECONOMIC IMPACT

                                               RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL               CODE      FREQ     (PCT)      (PCT)      (PCT)

YES                           C         59      12.8      100.0      100.0

                                        401      87.2     MISSING    100.0
                                     -------   -------   -------
                             TOTAL      460     100.0      100.0

VALID CASES       59      MISSING CASES   401
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

Q185       OSHA REGS TO HAVE ECONOMIC IMPACT

                                                RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ     (PCT)      (PCT)     (PCT)

YES                               D       110      23.9      100.0     100.0

                                          350      76.1     MISSING    100.0
                                        ------    ------    ------
                                TOTAL     460     100.0      100.0

VALID CASES      110       MISSING CASES   350

Q186       AIR POLL CONTROL REGS TO HAVE IMPACT

                                                RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ     (PCT)      (PCT)     (PCT)

YES                               E        46      10.0      100.0     100.0

                                          414      90.0     MISSING    100.0
                                        ------    ------    ------
                                TOTAL     460     100.0      100.0

VALID CASES       46       MISSING CASES   414

Q187       TSCA TO HAVE ECONOMIC IMPACT ON PLANT

                                                RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ     (PCT)      (PCT)     (PCT)

                                  F        67      14.6      100.0     100.0

                                          393      85.4     MISSING    100.0
                                        ------    ------    ------
                                TOTAL     460     100.0      100.0

VALID CASES       67       MISSING CASES   393
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

Q188      SAFE DRINKING WATER ACT TO HAVE IMPACT

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)      (PCT)      (PCT)

YES                           G          1        0.2      100.0      100.0

                                       459       99.8    MISSING      100.0
                                    ------     ------     ------
                            TOTAL      460      100.0      100.0

VALID CASES         1       MISSING CASES   459
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

Q189      NEW CAP COSTS TO MEET ALL REG AREAS

                                                   RELATIVE   ADJUSTED    CUM
                                        ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ      (PCT)      (PCT)     (PCT)

                                 500.        1        0.2        0.9       0.9
                                1000.        2        0.4        1.8       2.8
                                1500.        1        0.2        0.9       3.7
                                2000.        2        0.4        1.8       5.5
                                3000.        1        0.2        0.9       6.4
                                3100.        1        0.2        0.9       7.3
                                3200.        1        0.2        0.9       8.3
                                3500.        2        0.4        1.8      10.1
                                4500.        1        0.2        0.9      11.0
                                5000.       36        7.8       33.0      44.0
                                6000.        1        0.2        0.9      45.0
                                7500.        1        0.2        0.9      45.9
                                8000.        2        0.4        1.8      47.7
                               10000.       14        3.0       12.8      60.6
                               12000.        1        0.2        0.9      61.5
                               15000.        2        0.4        1.8      63.3
                               20000.       11        2.4       10.1      73.4
                               25000.        2        0.4        1.8      75.2
                               30000.        5        1.1        4.6      79.8
                               35000.        2        0.4        1.8      81.7
                               40000.        3        0.7        2.8      84.4
                               50000.        3        0.7        2.8      87.2
                               80000.        1        0.2        0.9      88.1
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

                    90000.        1         0.2         0.9       89.0
                   100000.        3         0.7         2.8       91.7
                   125000.        1         0.2         0.9       92.7
                   150000.        1         0.2         0.9       93.6
                   200000.        2         0.4         1.8       95.4
                   250000.        1         0.2         0.9       96.3
                   300000.        1         0.2         0.9       97.2
                   400000.        1         0.2         0.9       98.2
                   500000.        1         0.2         0.9       99.1
                  1200000.        1         0.2         0.9      100.0
                        0.      351        76.3     MISSING      100.0
                              -------     -------   -------
                     TOTAL      460       100.0       100.0
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

0190        ANNUAL OPER COSTS TO MEET ALL REG AREAS

                                                     RELATIVE  ADJUSTED    CUM
                                          ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                     CODE     FREQ       (PCT)     (PCT)     (PCT)

                                   100.        1        0.2       0.9       0.9
                                   150.        1        0.2       0.9       1.8
                                   250.        1        0.2       0.9       2.7
                                   500.        4        0.9       3.6       6.4
                                  1000.        8        1.7       7.3      13.6
                                  1200.        1        0.2       0.9      14.5
                                  1500.        2        0.4       1.8      16.4
                                  2000.       10        2.2       9.1      25.5
                                  2500.        1        0.2       0.9      26.4
                                  2700.        1        0.2       0.9      27.3
                                  3000.        4        0.9       3.6      30.9
                                  4000.        1        0.2       0.9      31.8
                                  5000.        6        1.3       5.5      37.3
                                  6000.       37        8.0      33.6      70.9
                                  6100.        1        0.2       0.9      71.8
                                  7000.        2        0.4       1.8      73.6
                                  7200.        1        0.2       0.9      74.5
                                  7500.        1        0.2       0.9      75.5
                                  8000.        3        0.7       2.7      78.2
                                  8500.        1        0.2       0.9      79.1
                                 10000.        3        0.7       2.7      81.8
                                 12000.        2        0.4       1.8      83.6
                                 15000.        4        0.9       3.6      87.3
```

```
03/21/78            FILE - INK      - CREATED 03/21/78

                              19000.        1         0.2         0.9       88.2
                              19500.        1         0.2         0.9       89.1
                              20000.        3         0.7         2.7       91.8
                              30000.        2         0.4         1.8       93.6
                              37500.        1         0.2         0.9       94.5
                              47000.        2         0.4         1.8       96.4
                              60000.        1         0.2         0.9       97.3
                              65000.        1         0.2         0.9       98.2
                             105000.        1         0.2         0.9       99.1
                             148000.        1         0.2         0.9      100.0
                                  0.      350        76.1     MISSING     100.0
                                        -------     -------    -------
                               TOTAL      460       100.0       100.0
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

RM1         WHITE LEAD PIGMENT

                                                RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)      (PCT)      (PCT)

NO. PLANTS USING                 A          9      2.0      100.0      100.0

                                          451     98.0     MISSING     100.0
                                       ------    ------     ------
                              TOTAL       460    100.0      100.0

VALID CASES        9      MISSING CASES   451


RM2         ANTIMONY OXIDE

                                                RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)      (PCT)      (PCT)

NO. PLANTS USING                 B          3      0.7      100.0      100.0

                                          457     99.3     MISSING     100.0
                                       ------    ------     ------
                              TOTAL       460    100.0      100.0

VALID CASES        3      MISSING CASES   457


RM3         ZINC SULFIDE

                                                RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)      (PCT)      (PCT)

NO. PLANTS USING                 C         51     11.1      100.0      100.0

                                          409     88.9     MISSING     100.0
                                       ------    ------     ------
                              TOTAL       460    100.0      100.0

VALID CASES       51      MISSING CASES   409
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

RM4       ZINC OXIDE

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  D         15       3.3     100.0     100.0

                                           445      96.7   MISSING     100.0
                                        ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES       15       MISSING CASES   445


RM5       ZINC OXIDE

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  E         52      11.3     100.0     100.0

                                           408      88.7   MISSING     100.0
                                        ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES       52       MISSING CASES   408


RM6       ZINC YELLOW

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  F          2       0.4     100.0     100.0

                                           458      99.6   MISSING     100.0
                                        ------    ------    ------
                                 TOTAL     460     100.0     100.0

VALID CASES        2       MISSING CASES   458
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

RM7       ZINC DUST

                                                   RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                   G         3        0.7     100.0     100.0

                                           457       99.3   MISSING     100.0
                                        ------     ------    ------
                                 TOTAL     460      100.0     100.0

VALID CASES        3      MISSING CASES   457


RM8       MISC NI AG CU PB OR BRONZE

                                                   RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                   H       268       58.3     100.0     100.0

                                           192       41.7   MISSING     100.0
                                        ------     ------    ------
                                 TOTAL     460      100.0     100.0

VALID CASES      268      MISSING CASES   192


RM9       CADMIUM RED

                                                   RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                   I        79       17.2     100.0     100.0

                                           381       82.8   MISSING     100.0
                                        ------     ------    ------
                                 TOTAL     460      100.0     100.0

VALID CASES       79      MISSING CASES   381
```

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RM10        CADMIUM

                                                     RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE      FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE      FREQ       (PCT)      (PCT)     (PCT)

NO. PLANTS USING                   J         50        10.9      100.0     100.0

                                            410        89.1     MISSING    100.0
                                         -------     -------    -------
                                 TOTAL      460       100.0      100.0

VALID CASES       50       MISSING CASES    410


RM11        CHROME GREEN

                                                     RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE      FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE      FREQ       (PCT)      (PCT)     (PCT)

NO. PLANTS USING                   K         24         5.2      100.0     100.0

                                            436        94.8     MISSING    100.0
                                         -------     -------    -------
                                 TOTAL      460       100.0      100.0

VALID CASES       24       MISSING CASES    436


RM12        CHROMIUM OXIDE

                                                     RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE      FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE      FREQ       (PCT)      (PCT)     (PCT)

NO. PLANTS USING                   L          1         0.2      100.0     100.0

                                            459        99.8     MISSING    100.0
                                         -------     -------    -------
                                 TOTAL      460       100.0      100.0

VALID CASES        1       MISSING CASES    459
```

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03/21/78          FILE - INK       - CREATED 03/21/78

RM13      CHROMIUM OXIDE

                                              RELATIVE   ADJUSTED    CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING              M         9        2.0      100.0     100.0

                                      451       98.0    MISSING     100.0
                                   ------     ------     ------
                            TOTAL     460      100.0      100.0

VALID CASES        9      MISSING CASES   451


RM14      CADMIUM YELLOW OR ORANGE

                                              RELATIVE   ADJUSTED    CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING              A        64       13.9      100.0     100.0

                                      396       86.1    MISSING     100.0
                                   ------     ------     ------
                            TOTAL     460      100.0      100.0

VALID CASES       64      MISSING CASES   396


RM15      CHROME YELLOW

                                              RELATIVE   ADJUSTED    CUM
                                   ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL              CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING              B       322       70.0      100.0     100.0

                                      138       30.0    MISSING     100.0
                                   ------     ------     ------
                            TOTAL     460      100.0      100.0

VALID CASES      322      MISSING CASES   138
```

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RM16      CHROME ORANGE

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                C        24         5.2      100.0      100.0

                                        436        94.8     MISSING     100.0
                                      ------     ------     ------
                              TOTAL     460       100.0      100.0

VALID CASES       24      MISSING CASES   436


RM17      MOLYBDATE ORANGE WITH CR OR PB

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                D       307        66.7      100.0      100.0

                                        153        33.3     MISSING     100.0
                                      ------     ------     ------
                              TOTAL     460       100.0      100.0

VALID CASES      307      MISSING CASES   153


RM18      LEAD

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                E         6         1.3      100.0      100.0

                                        454        98.7     MISSING     100.0
                                      ------     ------     ------
                              TOTAL     460       100.0      100.0

VALID CASES        6      MISSING CASES   454
```

```
03/21/78          FILE - INK      - CREATED 03/21/78

RM19       PHLOXINE RED

                                                    RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                   CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                  F        129        28.0      100.0      100.0

                                           331        72.0     MISSING     100.0
                                         -------    -------    -------
                                 TOTAL     460       100.0      100.0

VALID CASES      129      MISSING CASES    331


RM20       LEAD

                                                    RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                   CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                  G          3         0.7      100.0      100.0

                                           457        99.3     MISSING     100.0
                                         -------    -------    -------
                                 TOTAL     460       100.0      100.0

VALID CASES        3      MISSING CASES    457


RM21       SILVER BLUE

                                                    RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                   CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                  H         57        12.4      100.0      100.0

                                           403        87.6     MISSING     100.0
                                         -------    -------    -------
                                 TOTAL     460       100.0      100.0

VALID CASES       57      MISSING CASES    403
```

```
RM22       IRON BLUE WITH CYANIDES


                                                    RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                   I        299       65.0      100.0     100.0

                                            161       35.0     MISSING    100.0
                                          -------   -------    -------
                                 TOTAL      460      100.0      100.0


VALID CASES      299      MISSING CASES    161


RM23       ZINC OR CHROMIUM BROWN GREY


                                                    RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                   J          1        0.2      100.0     100.0

                                            459       99.8     MISSING    100.0
                                          -------   -------    -------
                                 TOTAL      460      100.0      100.0


VALID CASES        1      MISSING CASES    459


RM24       PHTHALOCYANINE BLUE


                                                    RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                   K        343       74.6      100.0     100.0

                                            117       25.4     MISSING    100.0
                                          -------   -------    -------
                                 TOTAL      460      100.0      100.0


VALID CASES      343      MISSING CASES    117
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

RM25        PHTHALOCYANINE GREEN

                                                RELATIVE   ADJUSTED    CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                L       322       70.0      100.0      100.0

                                        138       30.0     MISSING     100.0
                                      ------    ------     ------
                               TOTAL    460      100.0      100.0

VALID CASES      322       MISSING CASES    138

RM26        CHROMIUM PIGMENTS

                                                RELATIVE   ADJUSTED    CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)      (PCT)      (PCT)

                                        460      100.0     MISSING     100.0
                                      ------    ------     ------
                               TOTAL    460      100.0      100.0

VALID CASES        0       MISSING CASES    460

RM27        ZINC PIGMENTS

                                                RELATIVE   ADJUSTED    CUM
                                     ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                N         1        0.2      100.0      100.0

                                        459       99.8     MISSING     100.0
                                      ------    ------     ------
                               TOTAL    460      100.0      100.0

VALID CASES        1       MISSING CASES    459
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

RM28      LEAD PIGMENTS

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)     (PCT)     (PCT)

                                       460      100.0    MISSING    100.0
                                     ------    ------    ------
                            TOTAL      460      100.0     100.0

VALID CASES        0       MISSING CASES   460



RM29      DICHLOROBENZIDENE DIARYLIDE ORANGE TONER

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING             P         204       44.3     100.0     100.0

                                       256       55.7    MISSING    100.0
                                     ------    ------    ------
                            TOTAL      460      100.0     100.0

VALID CASES      204       MISSING CASES   256



RM30      DICHLOROBENZIDENE DIARYLIDE YELLOW TONER

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING             A         318       69.1     100.0     100.0

                                       142       30.9    MISSING    100.0
                                     ------    ------    ------
                            TOTAL      460      100.0     100.0

VALID CASES      318       MISSING CASES   142
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

RM31        PYRAZOLONE RED

                                                  RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                   B        55      12.0      100.0      100.0

                                           405      88.0     MISSING     100.0
                                        ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES       55      MISSING CASES   405

RM32        MISC RED WITH ZINC,CR, OR PB

                                                  RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                   C        49      10.7      100.0      100.0

                                           411      89.3     MISSING     100.0
                                        ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES       49      MISSING CASES   411

RM33        MISC YELLOW WITH ANTIMONY OR CHROMIUM

                                                  RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                   D        41       8.9      100.0      100.0

                                           419      91.1     MISSING     100.0
                                        ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES       41      MISSING CASES   419
```

```
RM34      MISC YELLOW WITH CU OR DICHLOROBENZIDENE

                                                   RELATIVE   ADJUSTED    CUM
                                       ABSOLUTE      FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE      FREQ       (PCT)      (PCT)     (PCT)

NO. PLANTS USING                E          18         3.9      100.0     100.0

                                          442        96.1    MISSING     100.0
                                       ------      ------     ------
                               TOTAL      460       100.0      100.0

VALID CASES       18      MISSING CASES   442


RM35      MISC YELLOW WITH NICKEL

                                                   RELATIVE   ADJUSTED    CUM
                                       ABSOLUTE      FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE      FREQ       (PCT)      (PCT)     (PCT)

NO. PLANTS USING                F           3         0.7      100.0     100.0

                                          457        99.3    MISSING     100.0
                                       ------      ------     ------
                               TOTAL      460       100.0      100.0

VALID CASES        3      MISSING CASES   457


RM36      MISC CHROMIUM BLUE

                                                   RELATIVE   ADJUSTED    CUM
                                       ABSOLUTE      FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE      FREQ       (PCT)      (PCT)     (PCT)

NO. PLANTS USING                G           2         0.4      100.0     100.0

                                          458        99.6    MISSING     100.0
                                       ------      ------     ------
                               TOTAL      460       100.0      100.0

VALID CASES        2      MISSING CASES   458
```

```
03/21/78          FILE - INK        - CREATED 03/21/78

RM37      MISC CADMIUM BLUES

                                                   RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE      FREQ        (PCT)      (PCT)      (PCT)

NO. PLANTS USING                H           2          0.4      100.0      100.0

                                          458         99.6    MISSING      100.0
                                       ------       ------     ------
                              TOTAL       460        100.0      100.0

VALID CASES        2       MISSING CASES    458

RM38      MISC COPPER BLACK

                                                   RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE      FREQ        (PCT)      (PCT)      (PCT)

NO. PLANTS USING                I           4          0.9      100.0      100.0

                                          456         99.1    MISSING      100.0
                                       ------       ------     ------
                              TOTAL       460        100.0      100.0

VALID CASES        4       MISSING CASES    456

RM39      MISC         CHROMIUM BLACK

                                                   RELATIVE   ADJUSTED     CUM
                                       ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE      FREQ        (PCT)      (PCT)      (PCT)

                                          460        100.0    MISSING      100.0
                                       ------       ------     ------
                              TOTAL       460        100.0      100.0

VALID CASES        0       MISSING CASES    460
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03/21/78          FILE - INK      - CREATED 03/21/78

RM40      MISC ANTIMONY LEAD OR ZINC YELLOW

                                                     RELATIVE  ADJUSTED    CUM
                                           ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                      CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                     K         43       9.3     100.0     100.0

                                              417      90.7   MISSING     100.0
                                           -------   -------   -------
                                    TOTAL     460     100.0     100.0

VALID CASES       43       MISSING CASES   417


RM41      ANTIMONY WHITE AQUEOUS DISP

                                                     RELATIVE  ADJUSTED    CUM
                                           ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                      CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                     L          1       0.2     100.0     100.0

                                              459      99.8   MISSING     100.0
                                           -------   -------   -------
                                    TOTAL     460     100.0     100.0

VALID CASES        1       MISSING CASES   459


RM42      DICHLOROBENZIDENE RED AQ

                                                     RELATIVE  ADJUSTED    CUM
                                           ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                      CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                     M         28       6.1     100.0     100.0

                                              432      93.9   MISSING     100.0
                                           -------   -------   -------
                                    TOTAL     460     100.0     100.0

VALID CASES       28       MISSING CASES   432
```

```
03/21/78          FILE - INK       - CREATED 03/21/78

RM43      DICHLOROBENZIDENE YELLOW AO

                                                RELATIVE  ADJUSTED     CUM
                                       ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  N        90      19.6     100.0     100.0

                                          370      80.4   MISSING     100.0
                                       ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES       90       MISSING CASES    370

RM44      MISC GREEN WITH CR OR CU

                                                RELATIVE  ADJUSTED     CUM
                                       ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  O         2       0.4     100.0     100.0

                                          458      99.6   MISSING     100.0
                                       ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES        2       MISSING CASES    458



RM45      LEAD OR CHROME YELLOW AO

                                                RELATIVE  ADJUSTED     CUM
                                       ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  P        88      19.1     100.0     100.0

                                          372      80.9   MISSING     100.0
                                       ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES       88       MISSING CASES    372
```

```
RM46      NICKEL OR CADMIUM YELLOW AQ

                                           RELATIVE  ADJUSTED    CUM
                                 ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE     FREQ     (PCT)     (PCT)     (PCT)

                                    460     100.0    MISSING    100.0
                                  ------    ------    ------
                          TOTAL     460     100.0     100.0

VALID CASES       0     MISSING CASES   460



RM47      ORANGE LEAD AQ

                                           RELATIVE  ADJUSTED    CUM
                                 ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING           R         61      13.3     100.0     100.0

                                    399      86.7    MISSING    100.0
                                  ------    ------    ------
                          TOTAL     460     100.0     100.0

VALID CASES      61     MISSING CASES   399



RM48      DICLOROBENZIDENE ORANGE AQ

                                           RELATIVE  ADJUSTED    CUM
                                 ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL            CODE     FREQ     (PCT)     (PCT)     (PCT)

                           S          3       0.7     100.0     100.0

                                    457      99.3    MISSING    100.0
                                  ------    ------    ------
                          TOTAL     460     100.0     100.0

VALID CASES       3     MISSING CASES   457
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03/21/78          FILE - INK       - CREATED 03/21/78

RM49       COPPER OF CYANIDE GREEN AQ

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING              A        78       17.0     100.0     100.0

                                      382       83.0    MISSING    100.0
                                    ------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES       78      MISSING CASES   382


RM50       CHROMIUM GREEN AQ

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING              B         2        0.4     100.0     100.0

                                      458       99.6    MISSING    100.0
                                    ------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES        2      MISSING CASES   458



RM51       COPPER OR CYANIDE BLUE AQ

                                              RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL               CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING              C        91       19.8     100.0     100.0

                                      369       80.2    MISSING    100.0
                                    ------    ------    ------
                            TOTAL     460      100.0     100.0

VALID CASES       91      MISSING CASES   369
```

```
RM52      SILVER BLUE AQ

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING               D         1        0.2      100.0      100.0

                                       459       99.8     MISSING     100.0
                                    ------     ------     ------
                             TOTAL     460      100.0      100.0

VALID CASES        1      MISSING CASES   459


RM54      READ LEAD NON AQ

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING               F         3        0.7      100.0      100.0

                                       457       99.3     MISSING     100.0
                                    ------     ------     ------
                             TOTAL     460      100.0      100.0

VALID CASES        3      MISSING CASES   457


RM53      BLUE SILVER NON AQ

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE     FREQ       (PCT)      (PCT)      (PCT)

                                       460      100.0     MISSING     100.0
                                    ------     ------     ------
                             TOTAL     460      100.0      100.0

VALID CASES        0      MISSING CASES   460
```

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03/21/78          FILE - INK       - CREATED 03/21/78

RM55      CADMIUM OR SELENIUM RED NON AQ

                                                   RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ       (PCT)     (PCT)     (PCT)

NO. PLANTS USING                 G          2         0.4     100.0     100.0

                                          458        99.6   MISSING     100.0
                                       ------      ------    ------
                                TOTAL     460       100.0     100.0

VALID CASES        2      MISSING CASES   458


RM56      LEAD OR CHROMIUM YELLOW NON AQ

                                                   RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ       (PCT)     (PCT)     (PCT)

NO. PLANTS USING                 H         90        19.6     100.0     100.0

                                          370        80.4   MISSING     100.0
                                       ------      ------    ------
                                TOTAL     460       100.0     100.0

VALID CASES       90      MISSING CASES   370



RM57      DICHLOROBENZIDENE YELLOW NON AQ

                                                   RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE      FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ       (PCT)     (PCT)     (PCT)

NO. PLANTS USING                 I        139        30.2     100.0     100.0

                                          321        69.8   MISSING     100.0
                                       ------      ------    ------
                                TOTAL     460       100.0     100.0

VALID CASES      139      MISSING CASES   321
```

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03/21/78            FILE - INK      - CREATED 03/21/78

RM58      LEAD OR CHROME  ORANGE NON AQ

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                 J         84      18.3     100.0     100.0

                                          376      81.7   MISSING     100.0
                                       ------    ------    ------
                               TOTAL      460     100.0     100.0

VALID CASES       84      MISSING CASES   376


RM59      LEAD OR CHROMIUM BLUE NON AQ

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                 K          4       0.9     100.0     100.0

                                          456      99.1   MISSING     100.0
                                       ------    ------    ------
                               TOTAL      460     100.0     100.0

VALID CASES        4      MISSING CASES   456


RM60      LEAD OR CHROMIUM GREEN NON AQ

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                 L          4       0.9     100.0     100.0

                                          456      99.1   MISSING     100.0
                                       ------    ------    ------
                               TOTAL      460     100.0     100.0

VALID CASES        4      MISSING CASES   456
```

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03/21/78          FILE - INK       - CREATED 03/21/78

RM61        COPPER OR CYANIDE GREEN  NON AQ

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  M       144      31.3      100.0     100.0

                                          316      68.7     MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0      100.0

VALID CASES      144       MISSING CASES   316


RM62        COPPER OR CYANIDE BLUE NON AQ

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  A       166      36.1      100.0     100.0

                                          294      63.9     MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0      100.0

VALID CASES      166       MISSING CASES   294



RM63        SILVER BLUE         NON AQ

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  B         1       0.2      100.0     100.0

                                          459      99.8     MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0      100.0

VALID CASES        1       MISSING CASES   459
```

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03/21/78          FILE - INK      - CREATED 03/21/78

RM64      LEAD DRIERS

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)    (PCT)

NO. PLANTS USING                  A      140      30.4     100.0    100.0

                                         320      69.6    MISSING   100.0
                                       -------   -------   -------
                                TOTAL    460     100.0     100.0

VALID CASES      140      MISSING CASES   320

RM65      ZINC DRIERS

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)    (PCT)

NO. PLANTS USING                  B       60      13.0     100.0    100.0

                                         400      87.0    MISSING   100.0
                                       -------   -------   -------
                                TOTAL    460     100.0     100.0

VALID CASES       60      MISSING CASES   400

RM66      MISC DRIERS

                                                RELATIVE  ADJUSTED    CUM
                                      ABSOLUTE    FREQ      FREQ     FREQ
CATEGORY LABEL                  CODE    FREQ     (PCT)     (PCT)    (PCT)

NO. PLANTS USING                  C       37       8.0     100.0    100.0

                                         423      92.0    MISSING   100.0
                                       -------   -------   -------
                                TOTAL    460     100.0     100.0

VALID CASES       37      MISSING CASES   423
```

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03/21/78           FILE - INK        - CREATED 03/21/78

RM67       NAPHTHENATE DRIERS

                                                RELATIVE   ADJUSTED    CUM
                                      ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                D        173       37.6      100.0     100.0

                                         287       62.4     MISSING    100.0
                                      -------    -------    -------
                               TOTAL     460      100.0      100.0

VALID CASES      173      MISSING CASES    287

RM68       ZINC SOAPS

                                                RELATIVE   ADJUSTED    CUM
                                      ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                E         24        5.2      100.0     100.0

                                         436       94.8     MISSING    100.0
                                      -------    -------    -------
                               TOTAL     460      100.0      100.0

VALID CASES       24      MISSING CASES    436


RM69       LEAD SOAPS

                                                RELATIVE   ADJUSTED    CUM
                                      ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)     (PCT)

                                         460      100.0     MISSING    100.0
                                      -------    -------    -------
                               TOTAL     460      100.0      100.0

VALID CASES        0      MISSING CASES    460
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```
03/21/78          FILE - INK      - CREATED 03/21/78

RM70      DI N BUTYL PHTHALATE PLASTICIZERS

                                                  RELATIVE   ADJUSTED    CUM
                                        ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  G        129      28.0      100.0     100.0

                                           331      72.0     MISSING    100.0
                                         ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES      129      MISSING CASES   331


RM71      DIMETHYL PHTHALATE  PLASTICIZERS

                                                  RELATIVE   ADJUSTED    CUM
                                        ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  H         26       5.7      100.0     100.0

                                           434      94.3     MISSING    100.0
                                         ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES       26      MISSING CASES   434


RM72      DIETHYL PHTHALATE PLASTICIZERS

                                                  RELATIVE   ADJUSTED    CUM
                                        ABSOLUTE    FREQ       FREQ      FREQ
CATEGORY LABEL                   CODE     FREQ     (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  I         34       7.4      100.0     100.0

                                           426      92.6     MISSING    100.0
                                         ------    ------     ------
                                 TOTAL     460     100.0      100.0

VALID CASES       34      MISSING CASES   426
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```
03/21/79          FILE - INK       - CREATED 03/21/78

RM73        DI 2 ETHYL HEXYL PHTHALATE PLASTICIZERS

                                                 RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  J       124      27.0      100.0     100.0

                                          336      73.0     MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES      124       MISSING CASES   336

RM74        PARAPLEX

                                                 RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  K        60      13.0      100.0     100.0

                                          400      87.0     MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES       60       MISSING CASES   400


RM75        BUTYL BENZYL      PHTHALATE PLASTICIZER

                                                 RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  L        15       3.3      100.0     100.0

                                          445      96.7     MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES       15       MISSING CASES   445
```

```
RM76      LEAD STABILIZERS

                                                 RELATIVE   ADJUSTED    CUM
                                      ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  M        1        0.2      100.0     100.0

                                         459       99.8     MISSING    100.0
                                       -------    -------   -------
                                TOTAL    460      100.0      100.0


VALID CASES        1       MISSING CASES    459



RM77      ZINC OR CADMIUM STABILIZERS

                                                 RELATIVE   ADJUSTED    CUM
                                      ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  N        3        0.7      100.0     100.0

                                         457       99.3     MISSING    100.0
                                       -------    -------   -------
                                TOTAL    460      100.0      100.0


VALID CASES        3       MISSING CASES    457



RM78      LEAD OR PHENOL STABILIZER

                                                 RELATIVE   ADJUSTED    CUM
                                      ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                  CODE    FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  A       23        5.0      100.0     100.0

                                         437       95.0     MISSING    100.0
                                       -------    -------   -------
                                TOTAL    460      100.0      100.0


VALID CASES       23       MISSING CASES    437
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```
03/21/78          FILE - INK       - CREATED 03/21/78

RM79      PHENOL WETTING   AGENTS

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  B          8       1.7      100.0     100.0

                                           452      98.3     MISSING    100.0
                                        -------   -------   -------
                                  TOTAL    460     100.0     100.0

VALID CASES       8      MISSING CASES   452

RM80      MISC WETTING AGENTS

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  C         27       5.9      100.0     100.0

                                           433      94.1     MISSING    100.0
                                        -------   -------   -------
                                  TOTAL    460     100.0     100.0

VALID CASES      27      MISSING CASES   433

RM81      TOLUENE VISCOSITY AGENTS

                                                  RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  D          2       0.4      100.0     100.0

                                           458      99.6     MISSING    100.0
                                        -------   -------   -------
                                  TOTAL    460     100.0     100.0

VALID CASES       2      MISSING CASES   458
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```
03/21/78          FILE - INK        - CREATED 03/21/78

RM82      PHENOL ANTI SKIN AGENTS

                                                   RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE     FREQ     (PCT)      (PCT)      (PCT)

NO. PLANTS USING                   E         65      14.1      100.0      100.0

                                            395      85.9     MISSING     100.0
                                         ------    ------     ------
                                  TOTAL     460     100.0      100.0

VALID CASES       65       MISSING CASES   395


RM83      MERCURY PRESERVATIVES

                                                   RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE     FREQ     (PCT)      (PCT)      (PCT)

NO. PLANTS USING                   F          2       0.4      100.0      100.0

                                            458      99.6     MISSING     100.0
                                         ------    ------     ------
                                  TOTAL     460     100.0      100.0

VALID CASES        2       MISSING CASES   458


RM84      COPPER PRESERVATIVES

                                                   RELATIVE   ADJUSTED     CUM
                                         ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                    CODE     FREQ     (PCT)      (PCT)      (PCT)

NO. PLANTS USING                   G          6       1.3      100.0      100.0

                                            454      98.7     MISSING     100.0
                                         ------    ------     ------
                                  TOTAL     460     100.0      100.0

VALID CASES        6       MISSING CASES   454
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```
03/21/78          FILE - INK       - CREATED 03/21/78

RM85       PCP PRESERVATIVES

                                                  RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                  CODE      FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                  H          8        1.7      100.0      100.0

                                           452       98.3    MISSING      100.0
                                        ------     ------     ------
                                TOTAL      460      100.0      100.0

VALID CASES        8      MISSING CASES    452

RM86      ZINC PRESERVATIVES

                                                  RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                  CODE      FREQ      (PCT)      (PCT)      (PCT)

                                           460      100.0    MISSING      100.0
                                        ------     ------     ------
                                TOTAL      460      100.0      100.0

VALID CASES        0      MISSING CASES    460


RM87       OTHER PRESERVATIVES

                                                  RELATIVE   ADJUSTED     CUM
                                        ABSOLUTE    FREQ       FREQ       FREQ
CATEGORY LABEL                  CODE      FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                  J         19        4.1      100.0      100.0

                                           441       95.9    MISSING      100.0
                                        ------     ------     ------
                                TOTAL      460      100.0      100.0

VALID CASES       19      MISSING CASES    441
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RM88      NAPHTHA BASED RESINS

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL              CODE      FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING              A         36        7.8       100.0      100.0

                                       424       92.2      MISSING     100.0
                                    ------     ------      ------
                            TOTAL      460      100.0       100.0

VALID CASES       36      MISSING CASES   424


RM89      TOLUENE OR ETHYLBENZENE            SOLUBL

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL              CODE      FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING              B         83       18.0       100.0      100.0

                                       377       82.0      MISSING     100.0
                                    ------     ------      ------
                            TOTAL      460      100.0       100.0

VALID CASES       83      MISSING CASES   377


RM90      TOLUENE OR ETHYLBENZENE SOLUBLE RESINS

                                               RELATIVE   ADJUSTED     CUM
                                    ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL              CODE      FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING              C         62       13.5       100.0      100.0

                                       398       86.5      MISSING     100.0
                                    ------     ------      ------
                            TOTAL      460      100.0       100.0

VALID CASES       62      MISSING CASES   398
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03/21/78           FILE - INK       - CREATED 03/21/78

RM91        TOLUENE OR NAPHTHA SOLUBLE RESINS

                                              RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                D        36       7.8     100.0     100.0

                                        424      92.2   MISSING     100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES       36      MISSING CASES   424

RM92     TOLUENE OR            NAPHTHA ALKYD RESIN

                                              RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                E        15       3.3     100.0     100.0

                                        445      96.7   MISSING     100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES       15      MISSING CASES   445

RM93        TOLUENE OR METHYLENE CHLORIDE SOL.      R

                                              RELATIVE  ADJUSTED    CUM
                                     ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                F        66      14.3     100.0     100.0

                                        394      85.7   MISSING     100.0
                                     ------    ------    ------
                              TOTAL     460     100.0     100.0

VALID CASES       66      MISSING CASES   394
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RM94      TOLUENE OR NAPHTHA SOLUBLE POLYESTER

                                                       RELATIVE  ADJUSTED      CUM
                                              ABSOLUTE     FREQ      FREQ     FREQ
CATEGORY LABEL                        CODE        FREQ    (PCT)     (PCT)    (PCT)

NO. PLANTS USING                         G          41      8.9     100.0    100.0

                                                   419     91.1   MISSING    100.0
                                                ------   ------    ------
                                     TOTAL         460    100.0     100.0

VALID CASES       41       MISSING CASES   419


RM95      TOLUENE SOLUBLE EPOXY RESINS

                                                       RELATIVE  ADJUSTED      CUM
                                              ABSOLUTE     FREQ      FREQ     FREQ
CATEGORY LABEL                        CODE        FREQ    (PCT)     (PCT)    (PCT)

NO. PLANTS USING                         H          39      8.5     100.0    100.0

                                                   421     91.5   MISSING    100.0
                                                ------   ------    ------
                                     TOTAL         460    100.0     100.0

VALID CASES       39       MISSING CASES   421


RM96      TOLUENE SOLUBLE POLYAMIDE RESINS

                                                       RELATIVE  ADJUSTED      CUM
                                              ABSOLUTE     FREQ      FREQ     FREQ
CATEGORY LABEL                        CODE        FREQ    (PCT)     (PCT)    (PCT)

NO. PLANTS USING                         I          49     10.7     100.0    100.0

                                                   411     89.3   MISSING    100.0
                                                ------   ------    ------
                                     TOTAL         460    100.0     100.0

VALID CASES       49       MISSING CASES   411
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03/21/78          FILE - INK       - CREATED 03/21/78

RM97      TOLUENE SOLUBLE UREA RESINS

                                             RELATIVE  ADJUSTED     CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING              J        29       6.3     100.0     100.0

                                      431      93.7   MISSING     100.0
                                   ------    ------    ------
                            TOTAL     460     100.0     100.0

VALID CASES      29      MISSING CASES   431

RM98      NAPHTHA SOLUBLE      MELAMINE RESINS

                                             RELATIVE  ADJUSTED     CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING              K        43       9.3     100.0     100.0

                                      417      90.7   MISSING     100.0
                                   ------    ------    ------
                            TOTAL     460     100.0     100.0

VALID CASES      43      MISSING CASES   417

RM99      VINYL CHLORIDE DERIVATIVES

                                             RELATIVE  ADJUSTED     CUM
                                   ABSOLUTE    FREQ      FREQ      FREQ
CATEGORY LABEL              CODE     FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING              L        91      19.8     100.0     100.0

                                      369      80.2   MISSING     100.0
                                   ------    ------    ------
                            TOTAL     460     100.0     100.0

VALID CASES      91      MISSING CASES   369
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03/21/78          FILE - INK       - CREATED 03/21/78

RM100     VINYL CHLORIDE DERIVED PVA


                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING              A        11        2.4      100.0      100.0

                                      449       97.6     MISSING     100.0
                                   ------     ------     ------
                             TOTAL    460      100.0      100.0


VALID CASES       11      MISSING CASES   449


RM101     PHENOL OR TOLUENE SOLUBLE PV ALCOHOL


                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING              B        22        4.8      100.0      100.0

                                      438       95.2     MISSING     100.0
                                   ------     ------     ------
                             TOTAL    460      100.0      100.0


VALID CASES       22      MISSING CASES   438



RM102     VINYL CHLORIDE VINYLIDENE CHLORIDE


                                              RELATIVE   ADJUSTED     CUM
                                   ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL               CODE    FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING              C         9        2.0      100.0      100.0

                                      451       98.0     MISSING     100.0
                                   ------     ------     ------
                             TOTAL    460      100.0      100.0


VALID CASES        9      MISSING CASES   451
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03/21/78           FILE - INK       - CREATED 03/21/78

RM103      TOLUENE SOLUBLE ACRYLIC SOLIDS

                                               RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING              D         90      19.6     100.0     100.0

                                       370      80.4    MISSING    100.0
                                    ------    ------    ------
                            TOTAL      460     100.0     100.0

VALID CASES       90      MISSING CASES   370

RM104      TOLUENE SOLUBLE        ACRYLIC SOLUTIONS

                                               RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING              E         78      17.0     100.0     100.0

                                       382      83.0    MISSING    100.0
                                    ------    ------    ------
                            TOTAL      460     100.0     100.0

VALID CASES       78      MISSING CASES   382

RM105      TOLUENE SOLUBLE RUBBERS

                                               RELATIVE  ADJUSTED    CUM
                                    ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL              CODE      FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING              F         79      17.2     100.0     100.0

                                       381      82.8    MISSING    100.0
                                    ------    ------    ------
                            TOTAL      460     100.0     100.0

VALID CASES       79      MISSING CASES   381
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RM106     PHENOLIC   RESINS

                                                RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  G       157      34.1     100.0     100.0

                                          303      65.9    MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES     157      MISSING CASES   303


RM107     TOLUENE SOLUBLE STYRENE

                                                RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  H        53      11.5     100.0     100.0

                                          407      88.5    MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES      53      MISSING CASES   407


RM108     ETHYLBENZENE OR      PHENOL SOLUBLE OLE

                                                RELATIVE  ADJUSTED    CUM
                                       ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE    FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  I        96      20.9     100.0     100.0

                                          364      79.1    MISSING    100.0
                                        ------    ------    ------
                                 TOTAL    460     100.0     100.0

VALID CASES      96      MISSING CASES   364
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03/21/78          FILE - INK        - CREATED 03/21/78

RM109     TOLUENE OR NAPHTHA SOLUBLE        SILICON

                                                  RELATIVE  ADJUSTED     CUM
                                       ABSOLUTE     FREQ      FREQ       FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)      (PCT)

NO. PLANTS USING                 J         75       16.3     100.0      100.0

                                          385       83.7    MISSING     100.0
                                        ------     ------    ------
                                TOTAL     460      100.0     100.0

VALID CASES        75       MISSING CASES   385


RM110     TOLUENE SOLUBLE MALEIC SOLUTIONS

                                                  RELATIVE  ADJUSTED     CUM
                                       ABSOLUTE     FREQ      FREQ       FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)      (PCT)

NO. PLANTS USING                 K         44        9.6     100.0      100.0

                                          416       90.4    MISSING     100.0
                                        ------     ------    ------
                                TOTAL     460      100.0     100.0

VALID CASES        44       MISSING CASES   416


RM111     TOLUENE SOLUBLE URETHANE RESINS

                                                  RELATIVE  ADJUSTED     CUM
                                       ABSOLUTE     FREQ      FREQ       FREQ
CATEGORY LABEL                  CODE     FREQ      (PCT)     (PCT)      (PCT)

NO. PLANTS USING                 L         23        5.0     100.0      100.0

                                          437       95.0    MISSING     100.0
                                        ------     ------    ------
                                TOTAL     460      100.0     100.0

VALID CASES        23       MISSING CASES   437
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```
RM112     MISC RESINS

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                M         62        13.5      100.0      100.0

                                         398        86.5     MISSING     100.0
                                       ------     ------     ------
                               TOTAL     460       100.0      100.0

VALID CASES        62       MISSING CASES   398


RM113     BENZENE

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                A          6         1.3      100.0      100.0

                                         454        98.7     MISSING     100.0
                                       ------     ------     ------
                               TOTAL     460       100.0      100.0

VALID CASES         6       MISSING CASES   454


RM114     BENZENE TOLUENE MIXTURES

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                B          3         0.7      100.0      100.0

                                         457        99.3     MISSING     100.0
                                       ------     ------     ------
                               TOTAL     460       100.0      100.0

VALID CASES         3       MISSING CASES   457
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03/21/78          FILE - INK       - CREATED 03/21/78

RM115     TOLUENE

                                                  RELATIVE  ADJUSTED     CUM
                                         ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE      FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  C         160     34.8     100.0     100.0

                                            300     65.2    MISSING    100.0
                                         ------   ------    ------
                                 TOTAL      460    100.0     100.0

VALID CASES     160      MISSING CASES   300

RM116     TOLUENE ETHYLBENZENE MIXTURES

                                                  RELATIVE  ADJUSTED     CUM
                                         ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE      FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  D           4      0.9     100.0     100.0

                                            456     99.1    MISSING    100.0
                                         ------   ------    ------
                                 TOTAL      460    100.0     100.0

VALID CASES       4      MISSING CASES   456

RM117     ETHYLBENZENE

                                                  RELATIVE  ADJUSTED     CUM
                                         ABSOLUTE   FREQ      FREQ      FREQ
CATEGORY LABEL                   CODE      FREQ     (PCT)     (PCT)     (PCT)

NO. PLANTS USING                  E          29      6.3     100.0     100.0

                                            431     93.7    MISSING    100.0
                                         ------   ------    ------
                                 TOTAL      460    100.0     100.0

VALID CASES      29      MISSING CASES   431
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RM118     ISOPHORONE

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                F         30        6.5      100.0      100.0

                                         430       93.5     MISSING     100.0
                                       ------     ------     ------
                               TOTAL     460      100.0      100.0

VALID CASES       30       MISSING CASES   430


RM119     CARBON TETRACHLORIDE

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)      (PCT)

NO. PLANTS USING                G          1        0.2      100.0      100.0

                                         459       99.8     MISSING     100.0
                                       ------     ------     ------
                               TOTAL     460      100.0      100.0

VALID CASES        1       MISSING CASES   459


RM120     CHLOROBENZENE

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)      (PCT)

                                         460      100.0     MISSING     100.0
                                       ------     ------     ------
                               TOTAL     460      100.0      100.0

VALID CASES        0       MISSING CASES   460
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```
03/21/78          FILE - INK      - CREATED 03/21/78

RM121      1 2 4 TRICHLOROBENZENE

                                                RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)      (PCT)      (PCT)

                                        460      100.0     MISSING     100.0
                                      ------    ------     ------
                              TOTAL     460      100.0      100.0

VALID CASES       0     MISSING CASES   460


RM122      1-2-DICHLOROETHANE

                                                RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)      (PCT)      (PCT)

                                        460      100.0     MISSING     100.0
                                      ------    ------     ------
                              TOTAL     460      100.0      100.0

VALID CASES       0     MISSING CASES   460


RM123      1.1.1 TRICHLOROETHANE

                                                RELATIVE   ADJUSTED     CUM
                                     ABSOLUTE     FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE    FREQ      (PCT)      (PCT)      (PCT)
NO. PLANTS USING                K        41        8.9      100.0      100.0

                                        419       91.1     MISSING     100.0
                                      ------    ------     ------
                              TOTAL     460      100.0      100.0

VALID CASES      41     MISSING CASES   419
```

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03/21/78          FILE - INK       - CREATED 03/21/78

RM124     1.1.2 TRICHLOROETHANE


                                                   RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

NO. PLANTS USING                   L         1        0.2     100.0     100.0

                                           459       99.8   MISSING     100.0
                                        ------     ------    ------
                                 TOTAL     460      100.0     100.0


VALID CASES        1      MISSING CASES   459



RM125     BIS 2 CHLOROETHYL ETHER


                                                   RELATIVE  ADJUSTED    CUM
                                        ABSOLUTE     FREQ      FREQ      FREQ
CATEGORY LABEL                    CODE    FREQ      (PCT)     (PCT)     (PCT)

                                           460      100.0   MISSING     100.0
                                        ------     ------    ------
                                 TOTAL     460      100.0     100.0

VALID CASES        0      MISSING CASES   460
```

```
RM126     CHLOROFORM

                                                    RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  N          1         0.2      100.0     100.0

                                           459        99.8     MISSING    100.0
                                         ------     ------     ------
                                 TOTAL     460       100.0      100.0

VALID CASES        1      MISSING CASES   459


RM127      1.2 DICHLOROBENZENE

                                                    RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                  O          1         0.2      100.0     100.0

                                           459        99.8     MISSING    100.0
                                         ------     ------     ------
                                 TOTAL     460       100.0      100.0

VALID CASES        1      MISSING CASES   459


RM128      1.3 DICHLOROPROPYLENE

                                                    RELATIVE   ADJUSTED    CUM
                                         ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                    CODE     FREQ      (PCT)      (PCT)     (PCT)

                                           460       100.0     MISSING    100.0
                                         ------     ------     ------
                                 TOTAL     460       100.0      100.0

VALID CASES        0      MISSING CASES   460
```

```
RM129      METHYLENE CHLORIDE

                                                  RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                A         13         2.8      100.0      100.0

                                         447        97.2    MISSING      100.0
                                      ------      ------     ------
                               TOTAL     460       100.0      100.0

VALID CASES      13      MISSING CASES   447


RM130     THICHLOROETHYLENE

                                                  RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)      (PCT)      (PCT)

NO. PLANTS USING                B         32         7.0      100.0      100.0

                                         428        93.0    MISSING      100.0
                                      ------      ------     ------
                               TOTAL     460       100.0      100.0

VALID CASES      32      MISSING CASES   428


RM131      ETHYLENE DICHLORIDE

                                                  RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE      FREQ       FREQ       FREQ
CATEGORY LABEL                 CODE     FREQ       (PCT)      (PCT)      (PCT)

                                         460       100.0    MISSING      100.0
                                      ------      ------     ------
                               TOTAL     460       100.0      100.0

VALID CASES       0      MISSING CASES   460
```

```
03/21/79          FILE - INK       - CREATED 03/21/78

RM132     PERCHLOROETHYLENE

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                D        14        3.0       100.0     100.0

                                        446       97.0      MISSING    100.0
                                       ------    ------     ------
                               TOTAL    460      100.0      100.0

VALID CASES      14       MISSING CASES   446



RM133     NAPHTA

                                                 RELATIVE   ADJUSTED     CUM
                                      ABSOLUTE     FREQ       FREQ      FREQ
CATEGORY LABEL                 CODE     FREQ      (PCT)      (PCT)     (PCT)

NO. PLANTS USING                E        26        5.7       100.0     100.0

                                        434       94.3      MISSING    100.0
                                       ------    ------     ------
                               TOTAL    460      100.0      100.0

VALID CASES      26       MISSING CASES   434
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